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THE UNIVERSITY OF ALBERTA

THE EFFECT OF CLIMBING APPARATUS ON UPPER BODY STRENGTH

BY

© JOHN WALTER MYSLICKI

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

DEPARTMENT OF ELEMENTARY EDUCATION

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ABSTRACT

THE BASIC PURPOSE OF THIS INVESTIGATION WAS TO DETERMINE WHAT EFFECT THE USE OF FOLDAWAY CLIMBING APPARATUS HAD UPON THE UPPER BODY STRENGTH OF CHILDREN ENROLLED IN THE ELEMENTARY PHYSICAL EDUCATION PROGRAM.

THREE HUNDRED AND THIRTY-FIVE GRADE FOUR STUDENTS IN SCHOOLS WITH THE APPARATUS COMPRISED THE EXPERIMENTAL GROUP, WHILE ONE HUNDRED AND NINETY-THREE GRADE FOUR STUDENTS IN SCHOOLS WITHOUT THE APPARATUS COMPRISED THE CONTROL GROUP.

MOST CHILDREN WHO USED THE CLIMBING APPARATUS DID SO FOR TWO TEN MINUTE PERIODS A WEEK FOR TEN WEEKS EACH SCHOOL YEAR DURING THE FOUR YEAR PERIOD.

AN ASSESSMENT OF THE UPPER BODY STRENGTH OF EACH SUBJECT WAS MADE BY ADMINISTERING THE FOLLOWING TESTS: FLEXED ARM HANG, GRIP STRENGTH OF EACH HAND, AND PULL-UPS. SOCIO-ECONOMIC STATUS, AGE, HEIGHT AND WEIGHT WERE ALSO DETERMINED FOR EACH SUBJECT. THE SUBJECT'S WEIGHT IN POUNDS WAS DIVIDED BY HIS HEIGHT IN INCHES TO EXAMINE THE RELATIONSHIP BETWEEN BODY BUILD AND PERFORMANCE ON SELECTED MEASURES OF UPPER BODY STRENGTH. TESTS WERE ADMINISTERED BY THE RESEARCHER DURING THE THREE WEEK PERIOD FROM FEBRUARY 9 TO FEBRUARY 27, 1970.

ANALYSIS OF VARIANCE AND COVARIANCE, AND CORRELATIONS AND PROBABILITIES BETWEEN SELECTED VARIABLES WERE CALCULATED WITH THE IBM 360 COMPUTER.

THE FINDINGS INDICATE THAT BOYS TEND TO BE STRONGER THAN GIRLS, AND TEND TO BENEFIT MORE FROM USING THE CLIMBING APPARATUS THAN GIRLS, SPECIFICALLY ON THE CRITERION OF UPPER BODY STRENGTH. ALSO, AS ONE'S

WEIGHT-HEIGHT RATIO INCREASES (THAT IS, THE HEAVIER A PERSON IS AT ANY GIVEN HEIGHT) HIS ABILITY TO PERFORM THE FLEXED ARM HANG AND PULL-UPS TENDS TO DECREASE, WHILE HAND STRENGTH TENDS TO INCREASE.

ON THE BASIS OF THE FINDINGS, IT APPEARS THAT THE USE OF CLIMBING APPARATUS AFFECTS UPPER BODY STRENGTH; HOWEVER, A FULL ASSESSMENT OF THE VALUE OF CLIMBING APPARATUS MUST ALSO BE MADE IN TERMS OF ITS EFFECT ON GENERAL BODY MOBILITY, PUPIL ATTITUDES, AND TEACHER-PUPIL RELATIONSHIPS.

ACKNOWLEDGEMENTS

The writer wishes to express his appreciation to Dr. Myer Horowitz and Professor Stuart Robbins for their valued suggestions and assistance throughout this study, and to Dr. L. D. Nelson for his thought-provoking questions.

Appreciation is also extended to Miss Marion Irwin and other supervisory personnel of the Edmonton Public School Board for assistance rendered and for allowing the eight schools to be used for this study. Special thanks go to the principals, staff and students in each school who made the gathering of data a most pleasant and rewarding experience.

Sincere thanks also to Dr. G. Cathcart for his assistance in analyzing the data, and to Don Williams and the other graduate students for their invaluable assistance and suggestions throughout.

Special acknowledgement and thanks to my wife, Margarete, without whose assistance and encouragement this work would have been overwhelming.

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CHAPTER I

STATEMENT OF THE PROBLEM

Introduction

The large number of men rejected by the draft during World War II, coupled with the present incidence of deaths due to heart failure and other degenerative diseases, have led to concern about the state of physical fitness of Canadian citizens. The organization of jogging clubs, the success of health spas and the financing of sports facilities by the federal authorities are but a few examples which show the result of such concern. The recent inception of the Canada Games and Arctic Winter Games are also evidence that physical fitness is the concern of many Canadians.

Although the emphasis seems to be directed at the citizens who are past their teen years, one has only to look at the Centennial Fitness Program for Canadian Youth, instituted by the Department of Health and Welfare through its Advisory Council on Fitness and Amateur Sport (Canadian Association for Health, Physical Education and Recreation, 1967), to observe the interest of school children as they practised certain activities to attain a level of competence which would result

IN THEIR RECEIVING A GOLD, SILVER OR BRONZE MEDALLION.

PHYSICAL FITNESS HAS BEEN ONE OF THE OBJECTIVES OF PHYSICAL EDUCATION (PROVINCE OF ALBERTA CURRICULUM GUIDE FOR ELEMENTARY PHYSICAL EDUCATION, 1967, P. 1), AND MAY BE RECEIVING MORE STRESS PARTLY BECAUSE THE MAJORITY OF CHILDREN COME FROM URBAN SURROUNDINGS WHICH PROVIDE A NATURAL BARRIER TO ADVENTURE, AND HAVE LESS OPPORTUNITY THAN THEIR RURAL COUNTERPARTS TO ATTAIN A HIGH LEVEL OF PHYSICAL FITNESS (MORRIS, 1955, P. 40). THIS IS ESPECIALLY TRUE IN THE DEVELOPMENT OF UPPER BODY STRENGTH, PARTIALLY DUE TO THE LACK OF TREES AND OTHER NATURAL OBJECTS WHICH CAN BE USED FOR CLIMBING ON AND SWINGING FROM.

SO AS TO PROVIDE CHILDREN WITH THE OPPORTUNITY TO PURSUE THEIR NATURAL INTERESTS OF CLIMBING, HANGING AND SWINGING, AND TO DEVELOP THEIR UPPER BODY STRENGTH THROUGH THESE ACTIVITIES, SEVERAL URBAN SCHOOLS ARE BEING EQUIPPED WITH CLIMBING APPARATUS IN THE GYMNASIUM. THE APPARATUS USUALLY HAS FOUR SECTIONS WHICH CAN BE PULLED AWAY FROM THE WALL WHEN NEEDED. TWO SECTIONS ARE CONSTRUCTED LIKE LADDERS (FIG. 1 & 2), WITH THE RUNGS SPACED DIFFERENT WIDTHS APART, AND THE OTHER TWO SECTIONS HAVE CROSSBOARDS WHICH ARE TWO INCHES THICK AND SIX INCHES WIDE. THE CROSSBOARDS MAY BE MOVED UP OR DOWN DEPENDING ON THE TYPE OF ACTIVITY FOR WHICH THEY ARE USED. THE SUPPORTING BARS BETWEEN EACH SECTION MAY ALSO INCLUDE ROPES OR ROPE LADDERS WHICH ARE SECURED AT THE TOP. SUCH APPARATUS, WHEN USED DURING THE PHYSICAL EDUCATION PERIOD, SHOULD PROVIDE CHILDREN WITH AN OPPORTUNITY TO IMPROVE THEIR UPPER BODY STRENGTH IN ADDITION TO CONTRIBUTING TO THEIR GENERAL BODY MOBILITY.

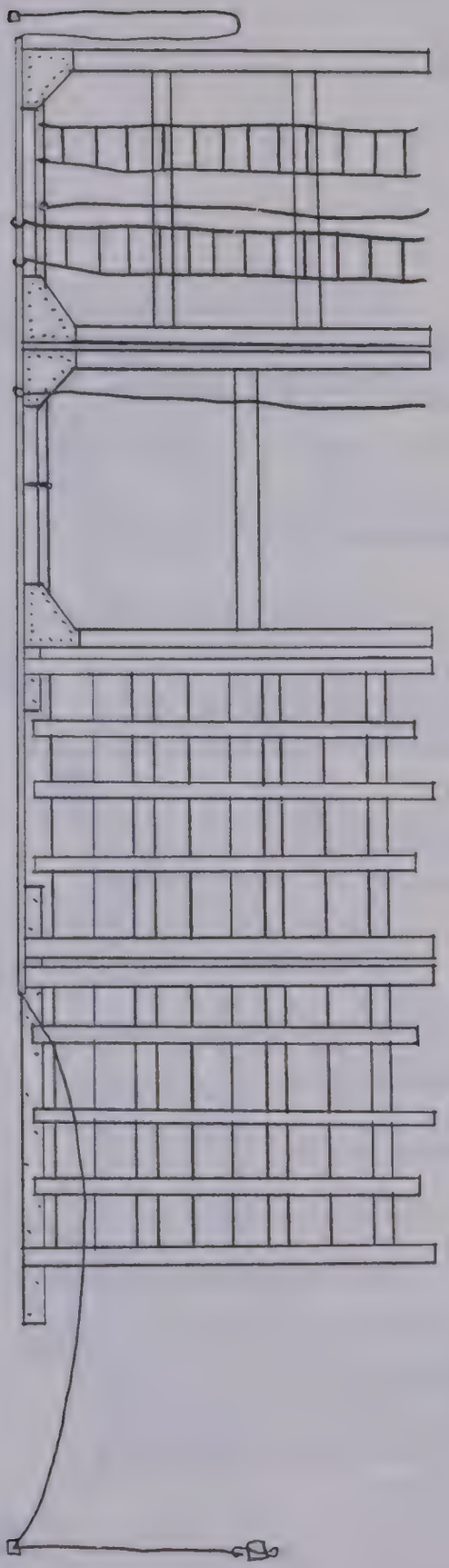

FIGURE 1. FOLDAWAY CLIMBING APPARATUS STORED AGAINST THE WALL

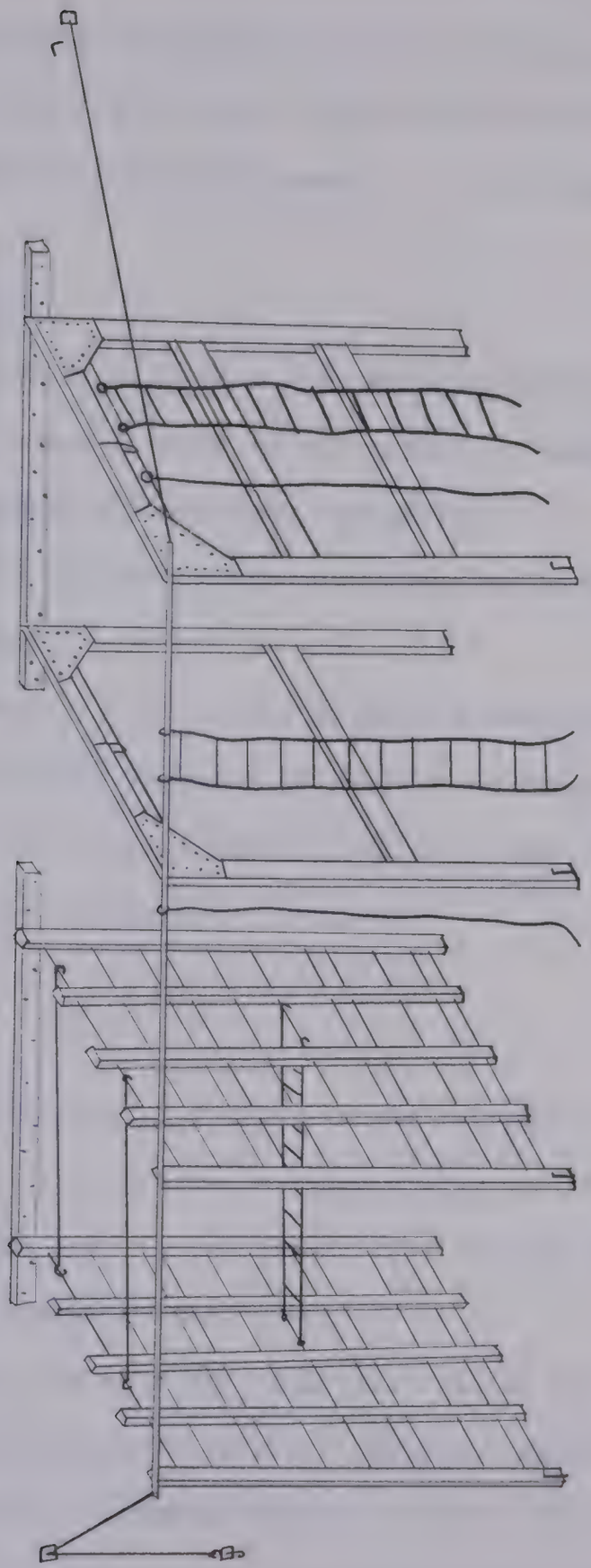

FIGURE 2. FOLDAWAY CLIMBING APPARATUS ASSEMBLED FOR USE

Problem

Does the use of foldaway climbing apparatus in elementary physical education make a significant contribution to the development of upper body strength of children enrolled in the program?

Specific Questions

1. Is there a relationship between weight-height ratio (a person's weight in pounds divided by his height in inches) and performance on selected measures of upper body strength?

2. Do boys perform better than girls on selected measures of upper body strength?

3. Is there a relationship between socio-economic status and performance on selected measures of upper body strength?

4. Is there a relationship between age and performance on selected measures of upper body strength?

Limitations

The investigation is limited in the following ways:

1. Because the physical fitness status of each subject was not assessed four years ago, it is assumed that the two groups were not significantly different at that time.

2. Because the physical education program and teachers throughout the four years were not identical for each subject, an assessment of the programs is being attempted through teacher-interviews.

3. Because control of the subjects' activities outside of physical education is not possible, it is assumed that these were not significantly different for both groups.

4. SELECTION OF A REPRESENTATIVE SAMPLE OF SUBJECTS WAS ATTEMPTED; HOWEVER, THE SMALL NUMBER OF SCHOOLS WHICH QUALIFIED AS EXPERIMENTAL RESULTED IN ALL SUBJECTS COMING FROM THE NORTH-EAST AND SOUTH-EAST QUADRANTS OF THE CITY OF EDMONTON.

5. ALTHOUGH THE EXPERIMENTAL SCHOOLS HAVE HAD THE FOLDAWAY CLIMBING APPARATUS FOR FOUR YEARS, IT IS POSSIBLE THAT THE APPARATUS WAS USED ONLY A SMALL PORTION OF THE TIME, OR NOT AT ALL.

6. ALTHOUGH THE CONTROL SCHOOLS HAVE HAD NO PERMANENT FOLDAWAY CLIMBING APPARATUS DURING THE FOUR YEAR PERIOD, THEY MAY HAVE HAD PORTABLE APPARATUS OR SOME FORM OF CLIMBING APPARATUS IN THE SCHOOL PLAYGROUND DURING SOME PORTION OF THIS TIME.

7. BECAUSE THE TESTS ARE LIMITED TO ASSESSMENT OF UPPER BODY STRENGTH, THE FINDINGS OF THIS STUDY CANNOT DETERMINE THE FULL WORTH OF THE CLIMBING APPARATUS. OTHER AREAS WHICH MUST RECEIVE CAREFUL CONSIDERATION ARE THE EFFECT OF CLIMBING APPARATUS UPON:

A) TEACHER AND PUPIL ATTITUDES,

B) TEACHER-PUPIL RELATIONSHIPS, AND

C) FLEXIBILITY AND GENERAL BODY MOBILITY.

DEFINITIONS

1. PHYSICAL FITNESS. THE ABILITY TO CARRY OUT DAILY TASKS WITHOUT UNDUE FATIGUE, AND WITH SUFFICIENT SURPLUS OF ENERGY TO ENJOY LEISURE TIME PURSUITS AND TO MEET UNFORESEEN EMERGENCIES.

2. STRENGTH. THE AMOUNT OF FORCE APPLIED BY A SPECIFIC GROUP OF MUSCLES.

A) ISOMETRIC - MUSCULAR ACTION IN WHICH NO MOVEMENT OR WORK IS DONE. PUSHING OR PULLING AGAINST A FIXED OBJECT.

b) isotonic - muscular action which leads to movement, and work is accomplished.

3. ENDURANCE. The ability of a group of muscles to exert force over an extended period of time.

4. UPPER BODY STRENGTH. The performance on a group of tests designed to assess the strength and endurance of muscles in the shoulder girdle and upper extremities of a human being.

5. AAHPER. American Association for Health, Physical Education and Recreation.

6. CAHPER. Canadian Association for Health, Physical Education and Recreation.

Significance of the Study

Discussions with supervisory staff of the Edmonton Public Schools revealed that informal strength tests were administered to children in that school system in the early 1960's. The data gathered at the time indicated that Edmonton children were below the national norm on measures of upper body strength. This assessment of strength was validated by Lucas in 1966 when he reported that although girls compared favorably with those of other studies, boys were significantly (.05 level of significance) lower than those of related studies (p. 150).

In an attempt to raise general motor ability and the upper body strength norms of Edmonton school children, foldaway climbing apparatus was installed in some of the elementary schools. To date (1970), no other research has been conducted in Alberta to determine the effect which such apparatus has had upon the development of upper body strength.

THE PURPOSE OF THIS STUDY IS TO DETERMINE WHAT EFFECT THE USE OF FOLDAWAY CLIMBING APPARATUS HAS UPON THE UPPER BODY STRENGTH OF CHILDREN ENROLLED IN THE ELEMENTARY PHYSICAL EDUCATION PROGRAM.

NULL HYPOTHESIS

AS WILL BECOME EVIDENT IN CHAPTER 2, WHEN THE RELATED LITERATURE IS REVIEWED, THERE IS NOT SUFFICIENT EVIDENCE FOR THE RESEARCHER TO PREDICT DIRECTION AT THIS TIME; CONSEQUENTLY, THE FOLLOWING HYPOTHESIS IS BEING USED:

THERE IS NO SIGNIFICANT DIFFERENCE BETWEEN STUDENTS WHO USED THE CLIMBER AND THOSE WHO DID NOT ON EACH OF THE FOLLOWING CRITERIA:

1. FLEXED ARM HANG,
2. GRIP STRENGTH OF THE RIGHT HAND,
3. GRIP STRENGTH OF THE LEFT HAND, AND
4. PULL-UPS.*

* THE TERMS ARE DESCRIBED FULLY IN CHAPTER 3.

CHAPTER II

REVIEW OF RELATED LITERATURE

Objectives of Physical Education

A researcher must be cognizant of the objectives which regulate the activity of the target program, namely, the physical education program at the elementary school level. It must be emphasized, then, that one of the universal objectives of physical education at all levels of education is the "improvement of physical fitness" (Bilbrough & Jones, 1965, p. 11; Clarke, 1967, p. 18; Friedenberg, 1966, p. 46; Kirchner, 1966, p. 7; Loken, 1958, p. 3; Morehouse & Miller, 1963, p. 268; Passmore, 1966, p. 20). One reason for the stress placed on this objective is put forth by Hetherington, who indicates that neuromuscular development must take place during the growth years because it is not as easily nor as effectively developed once maturity has been reached (1922, p. 27). "The skill and strength gained by youth in physical activity will help to guarantee physical efficiency in the adult" (Hetherington, 1922, p. 28). LaSalle (1957) suggests that through vigorous activity, the trained individual results. "The trained individual has a heart that nourishes the cells better than

THE UNTRAINED INDIVIDUAL, CARRIES AWAY WASTE PRODUCTS MORE EFFECTIVELY, AND SERVES THE INDIVIDUAL BETTER IN HIS DAY-TO-DAY LIVING" (P. 14). NASH (1948) AND BUCHER (1960) ALSO STRESS THE IMPORTANCE OF DEVELOPING PHYSICAL FITNESS THROUGH BIG-MUSCLE ACTIVITY SUCH AS HANGING, CLIMBING, RUNNING AND JUMPING BECAUSE SUCH ACTIVITIES PLAY A MAJOR ROLE IN DEVELOPMENT OF THE ORGANIC SYSTEMS OF THE BODY. THE ORGANIC SYSTEMS ARE STIMULATED AND TRAINED TO PROVIDE THE INDIVIDUAL WITH THE ABILITY TO PRODUCE PEAK PERFORMANCE IN ACTIVITY REQUIRING ENDURANCE, SKILL, SPEED, AGILITY AND STRENGTH (NASH, 1948, P. 31).

THE KEY OBJECTIVE OF PHYSICAL EDUCATION IS WELL SUMMARIZED BY KIRCHNER WHO STATES THAT "NORMAL GROWTH IS DEPENDENT UPON VIGOROUS ACTIVITY INVOLVING STRENGTH, ENDURANCE, AND GENERAL STAMINA" (1966, P. 16). IF THIS IS THE MAJOR OBJECTIVE, THEN "...THE SCHOOL IS OBLIGED TO ASSESS THE DEGREE TO WHICH PHYSICAL FITNESS IS BEING ATTAINED BY THE STUDENTS" (BOOKWALTER & VANDERZWAAG, 1969, P. 14).

WHILE IT IS CONCEDED THAT STRENGTH TESTS DO NOT MEASURE ALL ASPECTS OF PHYSICAL FITNESS, "THEY DO DEAL WITH A BASIC ELEMENT OF THE INDIVIDUAL'S GENERAL PHYSICAL STATUS" (CLARKE, 1967, P. 144). ROGERS (1934) SUPPORTS THIS VIEW WHEN HE STATES THAT IN HIS RESEARCH HE FOUND A HIGH POSITIVE CORRELATION BETWEEN MUSCULAR STRENGTH AND GENERAL HEALTH. ON THIS BASIS, THEN, "...DEVELOPMENT OF STRENGTH SHOULD BE OF UTMOST IMPORTANCE IN ANY PHYSICAL EDUCATION PROGRAM" (P. 43).

MCCLOY (1934), CONCERNING HIMSELF MORE SPECIFICALLY WITH THE IMPORTANCE OF UPPER BODY STRENGTH, FOUND THAT IN HIGH SCHOOL BOYS, THERE

WAS A VERY HIGH CORRELATION BETWEEN ARM AND SHOULDER STRENGTH AND VERTICAL JUMP, GENERAL MOTOR ABILITY, AND TRACK AND FIELD EVENTS (P. 11). FROM HIS OBSERVATIONS, MCCLOY CONCLUDED THAT "STRENGTH OF THE UPPER LIMBS IS IMPORTANT AS IT IS A PREREQUISITE TO SUPERIOR PERFORMANCE IN ANY FORM OF SPORTS" (P. 3).

CHILDREN HAVE PLENTY OF OPPORTUNITY TO DEVELOP LOWER BODY STRENGTH THROUGH THE EVERYDAY ACTIVITIES SUCH AS RUNNING, JUMPING, AND SKATING; THERE IS LESS OPPORTUNITY, HOWEVER, TO DEVELOP UPPER BODY STRENGTH. USING THIS AS ONE FACTOR WHICH MUST RECEIVE PRIORITY IN THE ELEMENTARY SCHOOL PHYSICAL EDUCATION PROGRAM, THE COLUMBIA COUNTY BOARD OF PUBLIC INSTRUCTION IN FLORIDA PREPARED A REPORT ON ELEMENTARY PHYSICAL EDUCATION EQUIPMENT (1967). THE REPORT RECOMMENDED THAT PARALLEL BARS, HORIZONTAL BARS, HORIZONTAL LADDER AND ROPE CLIMBING EQUIPMENT SHOULD BE A BASIC PART OF EVERY ELEMENTARY SCHOOL BECAUSE THESE WILL CONTRIBUTE SIGNIFICANTLY TO DEVELOPING ARM, SHOULDER AND ABDOMINAL MUSCLES AS WELL AS GRIP STRENGTH (PP. 21-27). FOLDAWAY CLIMBING APPARATUS SHOULD BE ABLE TO MAKE THE SAME SIGNIFICANT CONTRIBUTION TO UPPER BODY STRENGTH BECAUSE IT CAN BE SET UP IN SUCH A WAY THAT ALL OF THE ABOVE COMBINATIONS OF EQUIPMENT ARE AVAILABLE FOR USE AT THE SAME TIME (FIG. 2, P. 4). THIS POSITION IS SUPPORTED BY BELL WHO STATES THAT:

> THE DEVELOPMENT OF MUSCULAR STRENGTH REQUIRES PLACING THE MUSCLES UNDER STRESS; AND MODERATE STRESS MUST BE PROLONGED TO IMPROVE MUSCULAR ENDURANCE. AS THE BODY MAY BE UTILIZED AS THE RESISTANCE MEDIUM, THE USING OF CLIMBING APPARATUS MAY WELL PROVIDE A MEANS FOR DEVELOPING BOTH MUSCULAR STRENGTH AND ENDURANCE (1968, P. 5).

Research Non-supportive of Climbing Apparatus

In research related specifically to the effect of apparatus upon physical fitness, Wilbur (1943) conducted a study in which he compared two programs of physical education. One program stressed a sports method, wherein the subjects played games which were prevalent at that time. In the other program, subjects utilized gymnastics apparatus, climbing ropes, and a horizontal ladder. At the end of each program, all subjects were tested for development of physical fitness, and for arm and shoulder girdle strength. Wilbur concluded that the sports method was superior to the apparatus method for improving physical fitness. If the apparatus program was typical of that time, the subjects probably stood in line and waited for their turn more of the time than they were able to work on the apparatus. This might explain why the subjects using the apparatus method did not make significant gains in arm and shoulder girdle strength.

More recently, Bell (1968) studied the effects of climbing apparatus upon the muscular strength and endurance of grade four boys and girls in Victoria, British Columbia. The sample of 275 subjects came from nine classes. Three classes were taught and practised specific stunts on foldaway climbing apparatus; three classes played on foldaway climbing apparatus; and the three remaining classes were taught and practised individual and dual stunts with small equipment (hoops, ropes and benches). Each class had two physical education periods of thirty minutes each for ten weeks. Although all boys' and girls' groups improved significantly from pre-test to post-test, there were no significant differences between experimental and control

GIRLS. THE CONTROL BOYS, HOWEVER, WERE SIGNIFICANTLY BETTER THAN EITHER OF THE GROUPS OF EXPERIMENTAL BOYS ON THE POST-TEST.

RESEARCH SUPPORTIVE OF CLIMBING APPARATUS

MORRIS (1955) EXAMINED THE EFFECT OF SELECTED PLAYGROUND EQUIPMENT UPON UPPER BODY STRENGTH AND FLEXIBILITY OF PRIMARY GRADE CHILDREN. THE 94 EXPERIMENTAL SUBJECTS PARTICIPATED IN A PROGRAM WHICH INCLUDED THE USE OF DOORWAY GYM BARS, PARALLEL BARS, AND A COMBINATION UNIT OF HORIZONTAL AND VERTICAL LADDERS, PARALLEL AND HORIZONTAL BARS, RINGS AND TRAPEZE. THE 127 CONTROL SUBJECTS CONTINUED THEIR REGULAR PHYSICAL EDUCATION CLASSES WITHOUT THE USE OF SUCH APPARATUS. EACH GROUP HAD 30 PERIODS OF 15 MINUTES EACH OVER 11 WEEKS. THE EXPERIMENTAL GROUP WAS SIGNIFICANTLY BETTER THAN THE CONTROL GROUP ON ARM AND SHOULDER GIRDLE STRENGTH, WHILE FLEXIBILITY WAS NOT AFFECTED BY EITHER PROGRAM.

THE EFFECT OF SYSTEMATIC HORIZONTAL LADDER EXERCISES UPON UPPER BODY STRENGTH OF THIRD GRADE CHILDREN WAS INVESTIGATED BY HUTINGER (1955). UTILIZING A DAILY TEN MINUTE PERIOD FOR THREE MONTHS WITH 66 CHILDREN, HE FOUND THAT THE EXPERIMENTAL GROUPS MADE SIGNIFICANT GAINS IN PUSH-UPS, PULL-UPS, PUSHING AND PULLING STRENGTH.

ESTES (1959) INVESTIGATED THE ROLE OF CREATIVE PLAY EQUIPMENT IN DEVELOPING MUSCULAR FITNESS OF GRADE THREE CHILDREN. THE 27 CHILDREN IN THE EXPERIMENTAL GROUP WERE ASSIGNED STUNTS AND ACTIVITIES ON HORIZONTAL LADDERS, PARALLEL BARS, BALANCE BEAMS, BALANCE POLES, DOORWAY GYM BARS, ROPE AND SWEDISH VAULTING HORSE. AFTER A TEN WEEK PROGRAM OF TWO 25 MINUTE PERIODS EACH WEEK, ESTES FOUND THAT THE

EXPERIMENTAL GROUP MADE A SIGNIFICANT INCREASE IN ARM AND SHOULDER STRENGTH AS WELL AS IN STATIC BALANCE. FLEXIBILITY AND AGILITY WERE NOT SIGNIFICANTLY CHANGED.

IN A SUMMER CAMP FOR BOYS, POLLACK (1967) FOUND THAT UPPER BODY STRENGTH AND ENDURANCE OF MOST BOYS WERE UNDER DEVELOPED WHEN COMPARED TO 1962 NATIONAL NORMS OF BOYS IN UNITED STATES. THROUGH A SIX WEEK PROGRAM OF SPECIAL TRAINING (ROPE CLIMB, OVERHEAD LADDER WALK, MEDICINE BALL DRILLS, AND CALISTHENICS) SIGNIFICANT IMPROVEMENTS WERE ACHIEVED.

SUMMARY OF RELATED LITERATURE

1. ONE OF THE MAJOR OBJECTIVES OF PHYSICAL EDUCATION IS THE IMPROVEMENT OF PHYSICAL FITNESS.

2. STRENGTH TESTS DEAL WITH A BASIC ELEMENT OF THE INDIVIDUAL'S GENERAL PHYSICAL STATUS.

3. THERE APPEARS TO BE A HIGH CORRELATION BETWEEN MUSCULAR STRENGTH AND GENERAL PHYSICAL FITNESS.

4. ALTHOUGH CLIMBING APPARATUS SHOULD HAVE THE POTENTIAL OF INCREASING UPPER BODY STRENGTH, AND THUS IMPROVING THE GENERAL LEVEL OF PHYSICAL FITNESS, THERE IS INSUFFICIENT EVIDENCE TO SHOW THAT THIS IS SO.

CHAPTER III

METHODS AND PROCEDURE

The Sample

The sample was selected from the grade four students in the City of Edmonton Public Schools. Schools which have had a foldaway climbing apparatus in the gymnasium for a four year period were eligible to be chosen for the experimental group, while those which do not have such apparatus were eligible to be chosen for the control group.

Of the 11 schools which qualified as experimental, six were chosen by the researcher on the basis of their enrollment and geographic representativeness of the city. Six of the 28 control schools were selected on the basis of their proximity to one of the experimental school counterparts. Because of geographic proximity, out-of-school activities of subjects in the experimental and control schools were assumed to be not significantly different.

Of the six pairs of schools chosen by the researcher, school board officials selected four pairs for this study on the basis of

CONVENIENCE TO THE SCHOOL PERSONNEL INVOLVED.

ALL GRADE FOUR STUDENTS IN EACH OF THE EIGHT SCHOOLS COMPRISED THE TOTAL SAMPLE. (SEE TABLE 1 FOR THE BREAKDOWN OF THE SAMPLE.)

TABLE 1. THE SAMPLE

EXPERIMENTAL SCHOOLS	BOYS	GIRLS	TOTAL
SCHOOL A	62	45	107
SCHOOL B	46	36	82
SCHOOL C	37	37	74
SCHOOL D	37	35	72
			335
CONTROL SCHOOLS			
SCHOOL E	30	22	52
SCHOOL F	19	15	34
SCHOOL G	25	22	47
SCHOOL H	33	27	60
			193
		TOTAL SAMPLE	528

THE TESTS

THE FOLLOWING TESTS WERE ADMINISTERED IN THE ASSESSMENT OF UPPER BODY STRENGTH:

1. FLEXED ARM HANG. (SEE FIGURE 4.) ADOPTED FROM CAHPER (1966, P. 14).

EQUIPMENT - A DOORWAY GYM BAR PLACED SIX FEET FROM THE FLOOR, STOP WATCH.

START - THE SUBJECT TAKES A REVERSE GRASP ON THE BAR (PALMS TOWARD THE FACE). HE IS ASSISTED TO THE POSITION ON THE BAR SO THAT HIS EYES ARE AT THE LEVEL OF THE BAR. THE ARMS ARE FULLY BENT.

PERFORMANCE - THE SUBJECT HOLDS HIMSELF IN THIS HANGING POSITION AS LONG AS HE IS ABLE.

SCORING - THE TOTAL PERIOD OF TIME THAT THE SUBJECT CAN MAINTAIN THE EXACT POSITION IS DETERMINED TO THE NEAREST SECOND.

CONTROLS - THE SUBJECT MUST KEEP THE EYES ABOVE THE LEVEL OF THE BAR. WHEN THE SUBJECT'S EYES DROP BELOW THE BAR, THE TEST IS TERMINATED. ONE TRIAL IS ALLOWED. THE TESTER COUNTS THE SECONDS OUT LOUD.

2. GRIP STRENGTH. (SEE FIGURES 5 AND 6.) ADAPTED FROM LUCAS (1966, P. 52).

EQUIPMENT - SMEDLEY ADJUSTABLE GRIP DYNAMOMETER.

START - WHILE STANDING, THE SUBJECT IS INSTRUCTED AS TO THE MANNER OF CARRYING OUT THE SQUEEZING ACTION. THE TESTER PLACES THE DYNAMOMETER IN THE SUBJECT'S HAND SO THAT THE INNER HANDLE IS BETWEEN THE SECOND AND THIRD JOINTS OF THE MIDDLE FINGER (COUNTING AWAY FROM THE HAND) AND THE OUTER HANDLE IS AGAINST THE BASE OF THE HAND. THE DIAL OF THE DYNAMOMETER FACES AWAY FROM THE SUBJECT.

PERFORMANCE - THE SUBJECT'S ELBOW BEGINS IN AN EXTENDED POSITION AT HIS SIDE. AS HE SQUEEZES, THE ELBOW FLEXES UNTIL THE ANGLE IS LESS THAN 90 DEGREES. THE HANDS SHOULD NOT BE ALLOWED TO TOUCH THE BODY, OR ANY OTHER OBJECT, WHILE THE TEST IS BEING ADMINISTERED. IF THEY DO, THE SCORE SHOULD NOT BE READ AT ALL, AND

A RETEST SHOULD BE GIVEN AFTER A SHORT REST PERIOD OF 30 SECONDS.

SCORING - THE RIGHT HAND SHOULD BE TESTED FIRST AND THEN THE LEFT. SCORES SHOULD BE READ TO THE NEAREST POUND. THE INDICATOR SHOULD BE RETURNED TO ZERO AFTER EACH TEST.

3. PULL-UPS. (SEE FIGURE 3.) ADAPTED FROM ROGER'S PHYSICAL FITNESS INDEX (CLARKE, 1967, P. 152).

EQUIPMENT - A DOORWAY GYM BAR PLACED SEVEN FEET FROM THE FLOOR.

START - THE SUBJECT TAKES A FORWARD GRASP ON THE BAR (PALMS AWAY FROM THE FACE). HE IS ASSISTED TO THE BAR SO THAT HE GRASPS IT WITH HIS ARMS OUT-STRETCHED ABOVE HIS HEAD.

PERFORMANCE - THE SUBJECT CHINS HIMSELF AS MANY TIMES AS HE CAN. HE SHOULD PULL HIMSELF UP UNTIL HIS CHIN IS EVEN WITH HIS HANDS, THEN LOWER HIMSELF UNTIL HIS ARMS ARE STRAIGHT. (IF HIS FEET TOUCH THE FLOOR, HE SHOULD BEND HIS KNEES.) HE SHOULD NOT BE PERMITTED TO KICK, JERK, OR USE A KIP MOTION (BEND AT THE WAIST AND QUICKLY STRAIGHTEN OUT) IN PERFORMING THE MOVEMENT.

SCORING - A SCORE OF ONE-TENTH IS RECORDED IF THE SUBJECT IS UNABLE TO PULL HIMSELF UP ONE-HALF OF THE DISTANCE (FOR CONVENIENCE WITH THE TYPE OF COMPUTER PROGRAM USED). A SCORE OF ONE-HALF IS RECORDED IF THE SUBJECT DOES NOT PULL ALL THE WAY UP, BUT PAST THE ONE-HALF POINT. AFTER THE FIRST COMPLETED PULL-UP, HALF-COUNTS ARE RECORDED IF THE SUBJECT DOES NOT PULL ALL THE WAY UP, IF HE DOES NOT STRAIGHTEN HIS ARMS COMPLETELY WHEN LOWERING HIS BODY, OR IF HE KICKS, JERKS, OR KIPS IN PERFORMING THE PULL-UP. ONLY FOUR HALF-COUNTS ARE PERMITTED.

VERBAL ENCOURAGEMENT OR THE SHOUT TECHNIQUE WAS USED FOR EACH TEST.

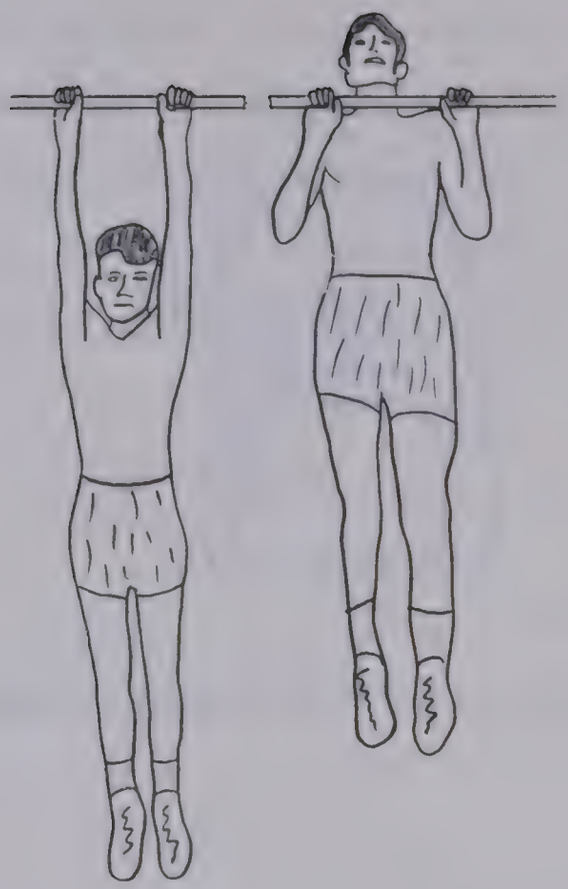

FIGURE 3. EXECUTION OF PULL-UPS

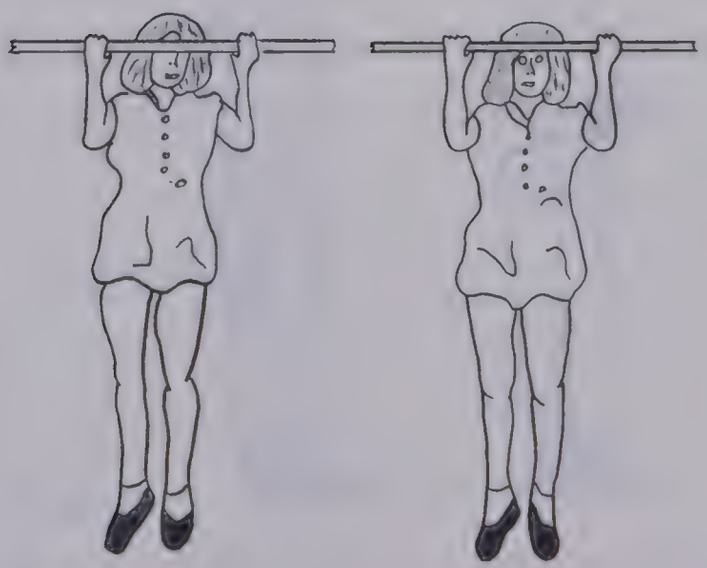

FIGURE 4. EXECUTION OF THE FLEXED ARM HANG

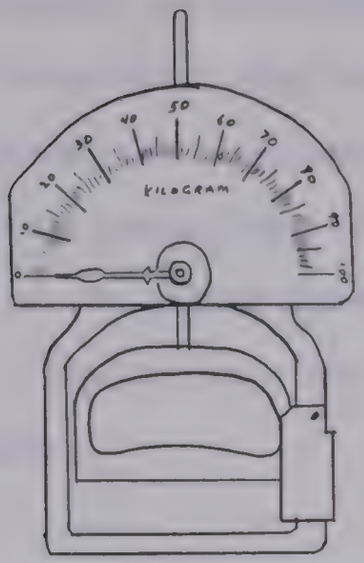

FIGURE 5. SMEDLEY ADJUSTABLE GRIP DYNAMOMETER

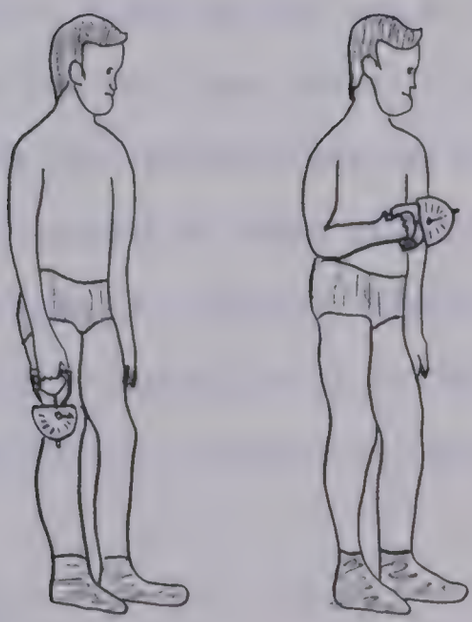

FIGURE 6. EXECUTION OF GRIP STRENGTH

The flexed arm hang and pull-ups were selected because they constitute a functional assessment of the strength of muscles in the shoulder girdle and upper extremities. The flexed arm hang is basically a measure of isometric strength, while pull-ups is a measure of isotonic strength. Magnusson (1957) and Morris (1955) report a reliability of .90 and .88, respectively, for the flexed arm hang. Collen (1969), using the same scoring as in the present study, reports test-retest reliability of .89 for pull-ups.

Since the fitness of a group of related muscles is limited by the strength of the weakest muscle in that group, an assessment of grip strength could prove useful in comparing the findings of the flexed arm hang and pull-ups in this study with those of other studies. If grip strength is very low, this would limit the performance on both the flexed arm hang and pull-ups, since neither can be performed unless the subject is able to support his full body weight by gripping the bar and holding onto it so that his feet do not touch the floor. Grip strength is also the "most reliable measure of human strength and the single item most reasonably representative of total body strength" (Bookwalter, 1950, p. 249). Lucas (1966) reports reliabilities of .95 for grip strength of the right hand and .90 for the left hand (p. 72).

Other Information Obtained

The following also were obtained for each subject:

1. height (to the nearest inch)
2. weight (to the nearest pound)
3. weight-height ratio (weight in pounds/height in inches)

4. OCCUPATION OF FATHER (USED TO DETERMINE THE SOCIO-ECONOMIC STATUS OF THE FAMILY AS DEFINED BY THE BLISHEN SCALE WHICH CLASSIFIES THE OCCUPATION ON THE BASIS OF EDUCATION REQUIRED FOR AND SALARY EARNED FROM THE JOB; BLISHEN, 1967, P. 42)
5. AGE IN MONTHS CALCULATED FROM THE DATE OF BIRTH
6. NUMBER OF YEARS HE HAD ATTENDED THIS SCHOOL.

ADMINISTRATION OF THE TESTS

THE TESTS WERE ADMINISTERED DURING THE THREE WEEK PERIOD FROM FEBRUARY 9 TO FEBRUARY 27, 1970. TO PREVENT UNDUE HARDSHIPS ON SCHOOL PERSONNEL, THE TESTS WERE ADMINISTERED IN THE HOMEROOM OF EACH CLASS. STRENGTH TESTS WERE ADMINISTERED BY THE RESEARCHER WHILE THE HOMEROOM TEACHER OBTAINED AND RECORDED THE HEIGHT AND WEIGHT OF EACH SUBJECT.

VALIDATION OF INSTRUMENTS

ALL HEIGHTS WERE DETERMINED BY THE METAL RULE ON THE DETECTO SCALE. DETECTO WEIGHT SCALE WAS CAREFULLY BALANCED FOR EACH SUBJECT. THE STOP WATCHES WERE CHECKED BY WOOLCO JEWELER'S DEPARTMENT, EDMONTON.

SMEDLEY ADJUSTABLE GRIP DYNAMOMETER WAS VALIDATED BY SUSPENDING WEIGHTS OF 11, 22, 33, AND 44 POUNDS FROM THE INNER HANDLE TO DETERMINE READINGS OF 5, 10, 15, AND 20 KILOGRAMS, RESPECTIVELY.

SOCIO-ECONOMIC STATUS WAS DETERMINED BY THE RESEARCHER AND THEN BY AN ASSISTANT. THE RESULTS WERE THEN COMPARED SO AS TO ACHIEVE THE MOST ACCURATE ASSESSMENT OF SOCIO-ECONOMIC STATUS AS INDICATED BY THE BLISHEN SCALE.

Data Collection

The testing equipment was set up in each home classroom so that the normal school program was disturbed as little as possible. An explanation of the purpose of the study was followed by a demonstration of each of the tests involved. Each subject was then given a data sheet (See Appendix A) and asked to fill in:

1. the name of his school
2. the number of years he had attended this school
3. his name
4. his sex
5. the occupation of his father
6. his age in years and months.

The researcher and homeroom teacher checked each subject's data sheet to see that all information was given and to provide help when the subject did not know what to write on the data sheet. The remaining information was collected in the following order (all students in a classroom completed one item before the next item was administered, thus ensuring sufficient rest between items):

1. weight and height - using a Detecto scale
2. flexed arm hang
3. grip strength of the right hand and of the left hand
4. pull-ups.

Teachers were requested to answer a questionnaire regarding the physical education program in their particular school. (Refer to Appendix A for questionnaire. Results of the questionnaire are summarized in Appendix D.)

Statistical Procedures

The data for each subject were punched on IBM data cards and analyzed with the following IBM 360 computer programs:

1. MULRØ5 (multiple linear regression analysis)*
   - A) means and standard deviations for each variable
   - B) analysis of variance for selected variables
   - C) analysis of covariance for selected combinations of variables.
2. ANOV15 (analysis of variance)
   - A) between-school comparison of mean scores on selected variables
   - B) Scheffé multiple matrix probabilities for difference between mean scores of each school.
3. DESTØ2 (descriptive statistics)
   - A) biserial correlations between all variables for total sample
   - B) probability that each correlation is equal to zero.
4. DESTØ6 (descriptive statistics)
   - A) histogram for each variable
   - B) range of scores for each variable
   - C) number of cases at each interval for a variable.

* The assumptions of randomness of sample, linearity and normality of data were met for this study. (See Appendix B and Appendix C.)

CHAPTER IV

FINDINGS AND DISCUSSION

INTRODUCTION

THE CHAPTER WILL BEGIN WITH ANALYSIS OF SIGNIFICANT CORRELATIONS BETWEEN VARIABLES FOR THE TOTAL SAMPLE. THIS WILL PROVIDE A BASIS FOR DISCUSSION OF DIFFERENCES FOUND BETWEEN CLIMBER AND NON-CLIMBER GROUPS LATER. FINDINGS OF THIS STUDY WILL BE COMPARED WITH THOSE OF OTHER STUDIES WHERE AVAILABLE.

CORRELATIONS BETWEEN VARIABLES

SIGNIFICANT FINDINGS FROM TABLE 2 MAY BE SUMMARIZED AS FOLLOWS:

1. GIRLS TEND TO BE SHORTER ($R = -0.15$, $P = .0008$)* AND LIGHTER ($R = -0.18$, $P = .00004$) THAN BOYS.

2. GIRLS TEND TO BE WEAKER THAN BOYS ON THE FOLLOWING MEASURES OF UPPER BODY STRENGTH:

   A) FLEXED ARM HANG ($R = -0.11$, $P < .00001$)

   B) GRIP STRENGTH OF THE RIGHT HAND ($R = -0.41$, $P < .00001$)

* R- BISERIAL CORRELATION
  P- PROBABILITY THAT THIS CORRELATION COULD HAPPEN BY CHANCE

Table 2

Biserial Correlations Between Variables for Total Sample

	Sex**	Socio-economic status	Age	Height	Weight	Flexed arm hang	Grip strength right	Grip strength left	Pull-ups
Sex									
Socio-economic status	0.058								
Age	-0.044	0.022							
Height	-0.146*	0.119*	0.191*						
Weight	-0.177*	0.083	0.105*	0.685*					
Flexed arm hang	-0.114*	-0.001	0.021	-0.173*	-0.343*				
Grip strength right	-0.407*	0.056	0.125*	0.473*	0.494*	0.075			
Grip strength left	-0.342*	0.069	0.139*	0.484*	0.513*	0.068	0.767*		
Pull-ups	-0.251*	-0.058	0.036	-0.257*	-0.282*	0.527*	0.114*	0.118*	
Weight-height ratio	-0.165*	0.062	0.063	0.492*	0.968*	-0.356*	0.438*	0.456*	-0.256*

* Significant at or beyond the .01 level of significance

** Minus (-) sign indicates that the boys have a higher score than girls on this variable

c) grip strength of the left hand ($R = -0.34$, $P < .00001$)

d) pull-ups ($R = -0.25$, $P < .00001$).

These findings are supported by Bookwalter and VanderZwaag (1969) who state that "boys tend to be taller and stronger than girls from birth to 11 years of age" (p. 11), and by Lucas (1966) who indicates that girls' mean scores on strength tend to be lower than boys' mean scores until 12 years of age (p. 150).

3. As one's weight-height ratio increases (that is, the heavier a person is at any particular height):

a) his ability to perform the flexed arm hang tends to decrease ($R = -0.36$, $P < .00001$)

b) the stronger he tends to become in his right hand ($R = 0.44$, $P < .00001$) and in his left hand ($R = 0.46$, $P < .00001$)

c) his ability to perform pull-ups tends to decrease ($R = -0.26$, $P < .00001$).

The grip strength findings are consistent with those of Bookwalter (1950) who used age in addition to height and weight.

4. Students coming from homes of high socio-economic status tend to be taller than students from low socio-economic homes ($R = 0.12$, $P = .006$).

In a comparison of today's children with those of 24 years ago, Espenschade and Meleney (1959) explained that better nutrition must account for today's children being taller (p. 187). It seems plausible that high socio-economic status children have better nutrition, and that the higher level of nutrition accounts for their being taller.

5. As a person gets older, he tends to get stronger in the right hand ($R = 0.13$, $P = .004$) and in his left hand ($R = 0.14$, $P = .0014$).

In establishing grip strength norms for males, Bookwalter (1950) indicates that there is a slow, regular progression in grip strength between the ages of nine and 14 (p. 251).

6. Children who perform well on the flexed arm hang also tend to do well on pull-ups ($R = 0.53$, $P = 0.0$).

Although the flexed arm hang is basically an isometric exercise and pull-ups are isotonic, both tests involve the same group of muscles.

7. Students who are strong in the right hand also tend to be strong in the left hand ($R = 0.12$, $P = 0.0$).

8. The ability of a person to perform pull-ups tends to increase as the strength increases in his right hand ($R = 0.11$, $P = .009$) and in his left hand ($R = 0.12$, $P = .007$).

Weight-Height Ratio

As indicated in Table 3, the mean weight-height ratios of subjects in five schools are not significantly different from the total mean, however, three schools warrant attention. The low weight-height ratio of students in Schools D and F may indicate that they should do well on the flexed arm hang and pull-ups, but not as well on grip strength of the right and left hands. (See finding #3 on page 27.) In contrast, there may be an indication that students in School G may do well on grip strength tests, but not as well on flexed arm hang and pull-ups.

Table 3

Means and Standard Deviations for Weight-Height Ratio

Climber Group	S.D.	Mean	Mean	S.D.	Non-Climber Group
Total Group	.18	1.29	1.30	.18	Total Group
School A	.18	1.31	1.30	.19	School E
School B	.18	1.31	1.26	.16	School F
School C	.19	1.30	1.33	.18	School G
School D	.16	1.23	1.30	.17	School H
Total Boys	.17	1.32	1.34	.19	Total Boys
Total Girls	.19	1.26	1.26	.15	Total Girls

Flexed Arm Hang

A comparison of students in each school with the Scheffé multiple comparison of means indicates that students in School F performed the flexed arm hang significantly better than students in School G at the .01 level of significance. One possible reason is that the students in School G had a higher weight-height ratio, and thus could not perform the exercise as well as School F students. Another contributing factor may be that students in School F have swimming as a part of their physical education program. The exercise of swimming, which relies mainly on the strength of the arms for propulsion, could well affect the strength of muscles in the arm and shoulder girdle. One other possible explanation for the difference may be that while School F students spend 40 to 50 percent of their time in physical education on activities that may affect upper body strength (derived from interviews with and questionnaires answered by physical education teachers in each school), students in School G spend only 25 to 35 percent of

THEIR TIME ON SUCH ACTIVITIES. SCHOOLS OTHER THAN F AND G WERE NOT SIGNIFICANTLY DIFFERENT IN THE PERFORMANCE OF THE FLEXED ARM HANG.

WHILE THE GIRLS IN THE CLIMBER SCHOOLS DID NOT PERFORM THE FLEXED ARM HANG SIGNIFICANTLY BETTER THAN THE GIRLS IN THE NON-CLIMBER SCHOOLS, THE CLIMBER BOYS WERE BETTER THAN THE NON-CLIMBER BOYS AT THE .06 LEVEL OF SIGNIFICANCE (SEE TABLE 4). THE DIFFERENCE BETWEEN SEXES WAS EXPLAINED IN Moving and Growing. "THE GIRLS USE MOMENTUM TO SWING THEMSELVES UP; THE BOYS, WITH STRONGER SHOULDER AND ARM MUSCLES, PULL THEMSELVES UP DIRECTLY" (1952, P. 9). BECAUSE THE FLEXED ARM HANG IS DEPENDENT ON PURE STRENGTH, THE BOYS MAKE MORE SIGNIFICANT GAINS THAN DO THE GIRLS.

TABLE 4

MEANS, STANDARD DEVIATION AND PROBABILITIES FOR THE FLEXED ARM HANG

CLIMBER GROUP	S.D.	MEAN	P*	MEAN	S.D.	NON-CLIMBER GROUP
TOTAL GROUP	26.23	41.10	.17	37.87	26.81	TOTAL GROUP
SCHOOL A	22.23	36.94	.99	39.08	25.87	SCHOOL E
SCHOOL B	21.76	39.59	.60	51.97	31.31	SCHOOL F
SCHOOL C	30.58	43.91	.12	27.55	20.98	SCHOOL G
SCHOOL D	30.08	46.10	.77	36.92	25.15	SCHOOL H
TOTAL BOYS	27.29	44.99	.06	38.72	27.81	TOTAL BOYS
TOTAL GIRLS	24.29	36.46	.91	36.81	25.79	TOTAL GIRLS

THE FINDINGS IN FAVOR OF THE CLIMBER GROUP FOR BOYS ARE SUPPORTED

* P INDICATES THE LEVEL OF SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE TWO MEAN SCORES

by Morris (1955) and Estes (1959). The mean scores reported by Bell (1968) for grade four students in Victoria, British Columbia are 20.37 for the girls and 32.33 for boys. The CAHPER Fitness Performance Manual for Canadian Youth (1966) reports a mean of 21.5 for ten year old girls and 32.8 for boys tested across Canada. It would appear that the students in this sample are superior when compared with other students studied in Canada on the flexed arm hang.

Grip Strength

On the basis of findings in Tables 5 and 6, there are no significant differences between the mean scores of students in each school or group on the measures of grip strength of both the right and left hands. These findings are not consistent with those of Morris (1955) who found that subjects in schools with climbing apparatus were significantly stronger in both hands than were control subjects.

Table 5

Means, Standard Deviations and Probabilities for Grip Strength of the Right Hand

Climber Group	S.D.	Mean	P	Mean	S.D.	Non-Climber Group
Total Group	7.37	33.75	.30	34.45	7.74	Total Group
School A	6.98	34.30	.99	35.28	8.44	School E
School B	6.56	33.70	.99	34.42	7.02	School F
School C	7.73	34.04	1.00	33.42	7.62	School G
School D	8.25	32.72	.96	34.54	7.49	School H
Total Boys	6.92	36.48	.33	37.34	7.88	Total Boys
Total Girls	6.57	30.51	.69	30.85	5.90	Total Girls

TABLE 6

MEANS, STANDARD DEVIATIONS AND PROBABILITIES FOR GRIP STRENGTH OF THE LEFT HAND

CLIMBER GROUP	S.D.	MEAN	P	MEAN	S.D.	NON-CLIMBER GROUP
TOTAL GROUP	7.35	32.45	.62	32.78	7.57	TOTAL GROUP
SCHOOL A	6.68	33.29	1.00	33.81	8.30	SCHOOL E
SCHOOL B	7.19	32.78	.99	31.71	6.23	SCHOOL F
SCHOOL C	7.57	32.93	.99	31.46	8.24	SCHOOL G
SCHOOL D	7.83	30.34	.52	33.55	6.76	SCHOOL H
TOTAL BOYS	7.35	34.91	.94	34.85	7.87	TOTAL BOYS
TOTAL GIRLS	6.22	29.53	.41	30.21	6.38	TOTAL GIRLS

GRIP STRENGTH SCORES OF TEN YEAR OLDS IN OTHER INVESTIGATIONS ARE REPORTED AS FOLLOWS: 35.3 FOR GIRLS AND 40.1 FOR BOYS (KEOGH, 1965), 27.4 FOR GIRLS AND 35.6 FOR BOYS (ESPENSCHADE & MELENEY, 1959), AND 38.97 FOR GIRLS AND BOYS (HUTINGER, 1955). COMPARISON WITH SUBJECTS OF OTHER INVESTIGATIONS APPEAR TO INDICATE, THEN, THAT THE SUBJECTS IN THIS SAMPLE ARE WEAKER WHEN MEASURED BY GRIP STRENGTH.

PULL-UPS

ANALYSIS OF TABLE 7 WITH SCHEFFÉ MULTIPLE COMPARISON OF MEANS INDICATES NO SIGNIFICANT DIFFERENCE BETWEEN ANY PARTICULAR SCHOOLS ON PULL-UPS; HOWEVER, THE BOYS IN SCHOOLS WITH CLIMBING APPARATUS PERFORMED SIGNIFICANTLY MORE PULL-UPS THAN BOYS IN CONTROL SCHOOLS (.05). IT IS ALSO INTERESTING TO NOTE THAT THE STUDENTS IN EVERY CLIMBER SCHOOL PERFORMED MORE PULL-UPS THAN STUDENTS IN EVERY NON-CLIMBER SCHOOL. THIS WOULD SEEM TO BE A VERY STRONG INDICATION THAT THE USE OF CLIMBING

apparatus in physical education has a positive effect upon upper body strength as measured by pull-ups. These findings are supported by Hutinger (1955); Estes (1959); Robson (1966); Pollack (1967); and Bell (1969), all of whom found that the boys made more significant gains than did the girls.

Table 7

Means, Standard Deviations and Probabilities for Pull-ups

Climber Group	S.D.	Mean	P	Mean	S.D.	Non-Climber Group
Total Group	2.56	1.83	.09	1.51	1.93	Total Group
School A	2.29	1.93	.99	1.66	1.96	School E
School B	2.03	1.74	.99	1.40	1.68	School F
School C	2.36	1.87	.98	1.39	1.21	School G
School D	2.34	1.74	.99	1.52	1.96	School H
Total Boys	2.58	2.41	.05	1.85	2.06	Total Boys
Total Girls	1.56	1.14	.74	1.07	1.62	Total Girls

While the subjects of this investigation were better than those in the United States, where the mean of one pull-up was reported, they did not do as well as British children who attained a mean score of four pull-ups (Campbell & Pohndorf, 1960). The boys in the climber group of this study also compare very favorably with fifth grade children studied by Taddonio (1961), who reports a mean score of 1.93 pull-ups.

General Discussion on Findings

One of the most interesting findings of this study is the correlation between weight-height ratio and performance on the tests of upper

BODY STRENGTH. AS ONE'S WEIGHT-HEIGHT RATIO INCREASES (THAT IS, AS A PERSON GAINS WEIGHT WITHOUT BECOMING TALLER), HIS ABILITY TO PERFORM THE FLEXED ARM HANG AND PULL-UPS DECREASES, WHILE HIS GRIP STRENGTH TENDS TO INCREASE. THIS COULD BE AN INDICATION THAT TESTING PROGRAMS WITH PHYSICAL PERFORMANCE STANDARDS BASED ON THE AGE OF THE INDIVIDUAL WITH NO REFERENCE TO HIS WEIGHT AND HEIGHT (FOR EXAMPLE, CENTENNIAL FITNESS PROGRAM FOR CANADIAN YOUTH) ARE DISCRIMINATORY AGAINST OVERWEIGHT CHILDREN. IT MAY BE PHYSICALLY IMPOSSIBLE FOR THEM TO REACH A STANDARD NO MATTER HOW HARD THEY TRY.

IN RELATION TO THE EFFECT OF CLIMBING APPARATUS ON UPPER BODY STRENGTH, IT SEEMS EVIDENT THAT BOYS BENEFIT MOST FROM THE USE OF SUCH APPARATUS, ESPECIALLY ON MEASURES INVOLVING THE MUSCLES OF THE SHOULDER GIRDLE. IT APPEARS AS THOUGH THE GIRLS DO NOT BENEFIT FROM THE USE OF SUCH APPARATUS; HOWEVER, IT MUST BE EMPHASIZED THAT UPPER BODY STRENGTH IS ONLY ONE AREA WHICH MAY BE AFFECTED BY THE USE OF CLIMBING APPARATUS.

THE STUDENTS IN THIS SAMPLE COMPARE FAVORABLY WITH STUDENTS IN OTHER STUDIES ON FLEXED ARM HANG AND PULL-UPS, BUT ARE NOT AS STRONG ON GRIP STRENGTH MEASURES.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The basic purpose of this investigation was to determine what effect the use of foldaway climbing apparatus had upon the upper body strength of children enrolled in the elementary physical education program.

Four experimental schools in the Edmonton Public School System were chosen on the basis of having had a permanent foldaway climbing apparatus in the gymnasium for four years. The four control schools were chosen because they did not have a permanent foldaway climbing apparatus in the gymnasium. All grade four students in each school were tested. This included 335 students in the experimental group and 193 students in the control group.

An assessment of the upper body strength of each subject was made by administering the following tests: flexed arm hang, grip strength of the right and left hands, and pull-ups. Other information

OBTAINED FOR EACH SUBJECT WAS SOCIO-ECONOMIC STATUS, AGE, HEIGHT AND WEIGHT. FOR THE PURPOSES OF THIS INVESTIGATION, THE SUBJECT'S WEIGHT IN POUNDS WAS DIVIDED BY HIS HEIGHT IN INCHES TO PROVIDE AN ASSESSMENT OF WHETHER HE WAS UNDERWEIGHT, AVERAGE WEIGHT, OR OVERWEIGHT. THIS RATIO WAS ALSO USED TO EXAMINE THE RELATIONSHIP BETWEEN BODY BUILD AND PERFORMANCE ON SELECTED MEASURES OF UPPER BODY STRENGTH. ALL TESTS WERE ADMINISTERED BY THE RESEARCHER. TESTS WERE ADMINISTERED DURING THE THREE-WEEK PERIOD FROM FEBRUARY 9 TO FEBRUARY 27, 1970.

ANALYSIS OF THE DATA WAS CARRIED OUT WITH THE FOLLOWING IBM 360 ELECTRONIC COMPUTER PROGRAMS: MULRØ5, ANOV15, DESTØ2, DESTØ6. THE FOLLOWING CALCULATIONS WERE PERFORMED WITH THE ABOVE PROGRAMS:

1. MEANS AND STANDARD DEVIATIONS WERE DERIVED FOR EACH VARIABLE
2. BISERIAL CORRELATIONS BETWEEN ALL VARIABLES WERE DETERMINED
3. PROBABILITY THAT EACH CORRELATION COULD HAPPEN BY CHANCE WAS DETERMINED
4. ANALYSIS OF VARIANCE FOR SELECTED VARIABLES WAS COMPUTED
5. ANALYSIS OF COVARIANCE FOR SELECTED COMBINATIONS WERE COMPUTED
6. SCHEFFÉ MULTIPLE MATRIX PROBABILITIES FOR DIFFERENCE BETWEEN MEAN SCORES ON SELECTED VARIABLES FOR EACH SCHOOL WAS ALSO CALCULATED.

THE FOLLOWING LIMITATIONS OF THE STUDY MUST RECEIVE CAREFUL ATTENTION:

1. PHYSICAL FITNESS STATUS OF SUBJECTS WAS NOT ASSESSED FOUR YEARS AGO

2. PROGRAM AND TEACHERS WERE NOT IDENTICAL FOR EACH GROUP OF SUBJECTS
3. CONTROL OF SUBJECTS' ACTIVITIES OUTSIDE OF PHYSICAL EDUCATION WAS NOT POSSIBLE
4. EXPERIMENTAL SCHOOLS MAY NOT HAVE MADE MUCH USE OF CLIMBING APPARATUS
5. CONTROL SCHOOL MAY HAVE HAD PORTABLE APPARATUS AT SOME TIME DURING THE FOUR YEAR PERIOD, OR SOME FORM OF CLIMBING APPARATUS IN THE PLAYGROUND
6. THE FINDINGS RELATED TO WEIGHT-HEIGHT RATIO MAY NOT APPLY TO ALL AGE LEVELS
7. BECAUSE THIS INVESTIGATION WAS LIMITED TO EFFECT OF CLIMBING APPARATUS UPON UPPER BODY STRENGTH, THE FINDINGS CANNOT DETERMINE THE FULL WORTH OF THE CLIMBING APPARATUS. OTHER AREAS WHICH REQUIRE CAREFUL CONSIDERATION INCLUDE: TEACHER AND CHILD ATTITUDES TOWARD PHYSICAL EDUCATION, TEACHER-CHILD RELATIONSHIPS, FLEXIBILITY AND GENERAL BODY MOBILITY OF THE CHILD.

IN LIGHT OF THE ABOVE LIMITATIONS, THE FOLLOWING SUMMARY STATEMENTS SEEM JUSTIFIED:

1. BOYS WHO HAD ACCESS TO FOLDAWAY CLIMBING APPARATUS DURING PHYSICAL EDUCATION WERE SIGNIFICANTLY STRONGER THAN THE BOYS IN THE CONTROL GROUP ON THE FLEXED ARM HANG ($P = .06$) AND ON PULL-UPS ($P = .05$), BUT NO SIGNIFICANT DIFFERENCES EXISTED ON GRIP STRENGTH.

2. GIRLS WHO HAD ACCESS TO FOLDAWAY CLIMBING APPARATUS DURING PHYSICAL EDUCATION WERE NOT SIGNIFICANTLY STRONGER THAN THE GIRLS IN

THE CONTROL GROUP ON FLEXED ARM HANG, PULL-UPS OR GRIP STRENGTH AS MEASURED IN THIS INVESTIGATION.

3. THE SUBJECTS IN THIS SAMPLE COMPARED FAVORABLY WITH THOSE IN OTHER STUDIES ON TESTS OF FLEXED ARM HANG AND PULL-UPS; HOWEVER, SUBJECTS IN OTHER STUDIES APPEAR TO BE STRONGER IN BOTH HANDS.

CONCLUSIONS AND RECOMMENDATIONS

WHILE IT IS CONCEDED THAT THE USE OF CLIMBING APPARATUS IN PHYSICAL EDUCATION BY ELEMENTARY STUDENTS DOES NOT APPEAR TO AFFECT THEIR GRIP STRENGTH IN EITHER HAND, THE BOYS WHO USED THE APPARATUS WERE SUPERIOR TO THOSE WHO DID NOT USE IT, ON THE CRITERION OF FLEXED ARM HANG. IT IS ALSO NOTEWORTHY THAT EACH GROUP OF STUDENTS IN THE SCHOOLS WHICH USED THE APPARATUS PERFORMED MORE PULL-UPS THAN EVERY GROUP OF STUDENTS IN SCHOOLS WHICH DID NOT HAVE THE APPARATUS. PULL-UPS WAS THE ONLY MEASURE OF UPPER BODY STRENGTH WHICH INVOLVED MUSCLES OF THE SHOULDER GIRDLE AND UPPER EXTREMITIES IN AN ISOTONIC CAPACITY, AND BECAUSE OF THIS, WAS PROBABLY THE MOST VALID ASSESSMENT OF TOTAL UPPER BODY STRENGTH. ON THIS BASIS, THEN, IT IS CONCLUDED THAT THE USE OF CLIMBING APPARATUS IN ELEMENTARY SCHOOL PHYSICAL EDUCATION DOES AFFECT UPPER BODY STRENGTH OF STUDENTS ENROLLED IN THAT PROGRAM.

INVESTIGATION OF THE EFFECT OF CLIMBING APPARATUS ON THE UPPER BODY STRENGTH OF CHILDREN GROUPED BY SEX INDICATES THAT THE BOYS APPEAR TO BENEFIT MORE FROM THE USE OF SUCH APPARATUS THAN THE GIRLS. THIS APPARENT DIFFERENCE MAY BE DUE TO THE DARING ATTITUDE OF BOYS WHICH MAY RESULT IN MORE CLIMBING AND HANGING ON THEIR PART. ALSO, THE BOYS MAY FIND THIS APPARATUS MORE CHALLENGING, AND THUS WORK HARDER THAN DO THE

GIRLS. ANOTHER POSSIBLE REASON FOR THE DIFFERENCE IS THAT THE BOYS MAY TEND TO CLIMB BY USING BRUTE STRENGTH, WHILE GIRLS MAY TEND TO CLIMB BY UTILIZING THEIR MOMENTUM, AND THUS IMPROVE IN BODY FLEXIBILITY AND MOBILITY BUT NOT IN UPPER BODY STRENGTH. THE APPARENT DIFFERENCES BETWEEN THE BENEFITS GAINED BY THE BOYS AND GIRLS SHOULD BE INVESTIGATED IN MORE DETAIL. THE FOLLOWING RECOMMENDATIONS FOR FURTHER RESEARCH MAY PROVIDE MORE INFORMATION AS TO WHY THE DIFFERENCES OCCUR. IT IS RECOMMENDED THAT THE FOLLOWING BE CONDUCTED:

1. INVESTIGATION OF THE ATTITUDE OF BOYS AND GIRLS TOWARD THE USE OF CLIMBING APPARATUS IN PHYSICAL EDUCATION.

2. INVESTIGATION OF THE ATTITUDE OF THE PHYSICAL EDUCATION TEACHER TOWARD THE USE OF CLIMBING APPARATUS IN PHYSICAL EDUCATION AND THE TYPE OF ACTIVITIES WHICH THEY EXPECT THE BOYS TO PERFORM AS OPPOSED TO THOSE THEY EXPECT FROM THE GIRLS.

3. INVESTIGATION OF THE TYPES OF ACTIVITIES BOYS PREFER TO PERFORM ON CLIMBING APPARATUS AS OPPOSED TO THOSE PREFERRED BY THE GIRLS.

4. INVESTIGATION OF THE EFFECT OF CLIMBING APPARATUS ON FLEXIBILITY AND GENERAL BODY MOBILITY OF CHILDREN TO DETERMINE IF DIFFERENCES EXIST BETWEEN BOYS AND GIRLS.

5. INVESTIGATION OF THE PARTS OF THE CLIMBING APPARATUS WHICH BOYS PREFER IN COMPARISON TO THOSE PREFERRED BY GIRLS.

6. INVESTIGATION OF THE EFFECT OF CLIMBING APPARATUS ON THE STRENGTH, FLEXIBILITY AND GENERAL BODY MOBILITY OF BOYS AND GIRLS WHO HAVE PHYSICAL EDUCATION TOGETHER AS OPPOSED TO THOSE WHO PARTICIPATE IN AN ALL BOY OR ALL GIRL CLASS.

7. INVESTIGATION OF THE EFFECT OF CLIMBING APPARATUS ON THE STRENGTH, FLEXIBILITY AND GENERAL BODY MOBILITY OF CHILDREN WHO COME

FROM AN URBAN SETTING AS COMPARED WITH CHILDREN WHO COME FROM A NON-URBAN SETTING.

THE FINDINGS FROM THE ABOVE INVESTIGATIONS MAY SUGGEST CHANGES IN:

1. THE TYPES OF ACTIVITIES WHICH THE TEACHER REQUESTS OF THE CHILDREN DEPENDING ON THE OBJECTIVES TO BE OBTAINED.

2. THE APPARATUS WHICH WILL SERVE THE NEEDS AND INTERESTS OF THE CHILDREN.

3. THE APPROACH TO PHYSICAL EDUCATION AS A COEDUCATIONAL ACTIVITY.

CATEGORIZING STUDENTS ACCORDING TO THE NUMBER OF YEARS THEY ATTENDED THE SCHOOL WITH A CLIMBING APPARATUS DID NOT YIELD ANY MORE INFORMATION THAN PUTTING ALL STUDENTS FROM CLIMBER SCHOOLS INTO ONE CATEGORY. THIS MAY INDICATE THAT THERE IS SOME AMOUNT OF TIME BEYOND WHICH THE CLIMBER DOES NOT HAVE TOO MUCH EFFECT UPON THE UPPER BODY STRENGTH OF CHILDREN WHO USE IT. ON THE BASIS OF THIS FINDING, IT IS RECOMMENDED THAT THE EFFECT OF CLIMBING APPARATUS ON UPPER BODY STRENGTH BE INVESTIGATED WHEREIN THE CHILDREN ARE TESTED AT SELECTED PERIODS OF TIME TO DETERMINE IF THE DEVELOPMENT OF UPPER BODY STRENGTH BEGINS TO PLATEAU, AND IF SO, WHAT AMOUNT OF TIME DEVOTED TO USE OF CLIMBING APPARATUS WOULD RESULT IN OPTIMUM DEVELOPMENT OF UPPER BODY STRENGTH.

WHILE THE USE OF CLIMBING APPARATUS APPEARED TO IMPROVE THE STUDENTS' ABILITY TO PERFORM THE FLEXED ARM HANG AND PULL-UPS, IT SEEMS AS THOUGH GRIP STRENGTH WAS NOT AFFECTED. IT MAY BE POSSIBLE THAT GRIP STRENGTH WAS AFFECTED; HOWEVER, THE CHILDREN WERE UNABLE TO APPLY MORE PRESSURE TO THE ADJUSTABLE GRIP DYNAMOMETER BECAUSE IT WAS TOO HEAVY TO

LIFT AND SQUEEZE AT THE SAME TIME. A RECTANGULAR HAND MANUOMETER MAY BE BETTER FOR THIS AGE GROUP BECAUSE IT IS LIGHTER AND CAN BE HELD WITHIN THE PALM OF THE HAND. IT IS RECOMMENDED THAT THE MERITS OF BOTH TYPES OF INSTRUMENTS BE CAREFULLY CONSIDERED BEFORE SELECTING ONE TYPE OR THE OTHER FOR A SIMILAR STUDY. A PILOT STUDY UTILIZING BOTH TYPES OF INSTRUMENTS SHOULD PROVIDE SUFFICIENT EVIDENCE TO DETERMINE WHICH ONE BEST SERVES THE PURPOSE.

THE MAJORITY OF CLASSES IN THIS INVESTIGATION WERE TAUGHT BY HOMEROOM TEACHERS WHO INDICATED THAT THEY DID NOT HAVE ENOUGH INFORMATION ABOUT HOW THE CLIMBING APPARATUS COULD BE ASSEMBLED AND USED IN PHYSICAL EDUCATION. IF, IN FACT, THE APPARATUS WAS NOT USED IN SUCH A WAY AS TO PROVIDE THE GREATEST BENEFITS TO THE STUDENTS, IT IS POSSIBLE THAT THE USE OF CLIMBING APPARATUS IN PHYSICAL EDUCATION CAN BENEFIT THE STUDENTS MUCH MORE THAN WAS INDICATED IN THIS STUDY. THIS POSSIBILITY SEEMS TO LEAD TO MANY QUESTIONS, SOME OF WHICH ARE THE FOLLOWING: WOULD A CLASS TAUGHT BY A PHYSICAL EDUCATION SPECIALIST MAKE MORE SIGNIFICANT GAINS ON THE APPARATUS THAN A CLASS TAUGHT BY A NON-SPECIALIST? WOULD AUDIO-VISUAL MATERIAL REGARDING THE ASSEMBLING AND USE OF CLIMBING APPARATUS MAKE A SIGNIFICANT CONTRIBUTION TO THE BENEFITS GAINED BY THE STUDENTS? WOULD A PROGRAM DESIGNED TO MAKE PRINCIPALS AWARE OF POSSIBILITIES FOR WHICH THE APPARATUS CAN BE USED AFFECT THE USE OF APPARATUS IN EACH SCHOOL? THE FOLLOWING RECOMMENDATIONS, IF CARRIED OUT, MAY PROVIDE THE ANSWERS TO SOME OF THE ABOVE QUESTIONS:

1. AN INVESTIGATION SHOULD BE CARRIED OUT TO DETERMINE THE EFFECT OF CLIMBING APPARATUS ON THE STRENGTH AND FLEXIBILITY OF STUDENTS TAUGHT BY A PHYSICAL EDUCATION SPECIALIST IN COMPARISON TO STUDENTS TAUGHT BY

A NON-SPECIALIST.

2. AN ATTEMPT SHOULD BE MADE TO PREPARE A SET OF AUDIO-VISUAL MATERIALS OUTLINING VARIATIONS IN ASSEMBLING THE APPARATUS, RELATING FLOORWORK ACTIVITY TO APPARATUS ACTIVITY, DEVELOPING A PROGRESSION OF LESSONS WHICH COULD BE USED WITH THE APPARATUS, AND SHOWING THE APPARATUS BEING USED BY STUDENTS. THE MATERIALS COULD INCLUDE 8MM FILM LOOPS WITH ACCOMPANYING WRITTEN MATERIALS, SLIDE SETS WITH TAPE RECORDED EXPLANATIONS, VIDEO-TAPE, AND DISPLAY BOARDS WITH PHOTOGRAPHS. THIS MATERIAL MUST BE READILY ACCESSIBLE TO THE TEACHERS AND PRINCIPALS, AND MUST BE PREPARED FOR THE TEACHER WHO HAS NOT HAD EXTENSIVE BACKGROUND IN THE PRESENT APPROACH TO PHYSICAL EDUCATION. IT WOULD ALSO BE USEFUL TO SHOW HOW THE PRESENT APPROACH IS COMPATIBLE WITH THE FORMAL APPROACH, AND HOW ONE CAN COMPLEMENT THE OTHER. THE MATERIAL WOULD HAVE TO BE COMPATIBLE WITH THE OBJECTIVES OF THE PHYSICAL EDUCATION PROGRAM, AND IT SEEMS, THEREFORE, THAT THE MATERIAL MUST BE PREPARED IN CONSULTATION WITH VARIOUS SCHOOL BOARDS AND UNIVERSITIES THROUGHOUT THE PROVINCE. SUCH CONSULTATIONS MIGHT ALSO PROVIDE THE BASIS FOR MODIFICATIONS OF THE PRESENT APPARATUS DEPENDING ON THE TYPE WHICH BEST MEETS THE NEEDS AND INTERESTS OF THE CHILDREN.

A Concluding Statement

IT APPEARS THAT THE USE OF CLIMBING APPARATUS AFFECTS UPPER BODY STRENGTH AND THAT THE CHILDREN'S ABILITY TO PERFORM ON SELECTED PHYSICAL FITNESS TESTS IS AFFECTED BY THEIR WEIGHT-HEIGHT RATIO.

BECAUSE OF THE SIGNIFICANT RELATIONSHIP BETWEEN WEIGHT-HEIGHT

RATIO AND PERFORMANCE ON SELECTED MEASURES OF UPPER BODY STRENGTH, IT IS RECOMMENDED THAT:

1. FURTHER INVESTIGATIONS BE CONDUCTED TO DETERMINE IF THE BODY MASS OF A PERSON AFFECTS HIS PERFORMANCE ON OTHER MEASURES OF FITNESS.

2. AN INVESTIGATION BE CONDUCTED TO DETERMINE THE VALIDITY OF ESTABLISHING PHYSICAL PERFORMANCE NORMS ON THE BASIS OF AGE ALONE RATHER THAN ON THE BASIS OF A COMBINATION OF AGE AND WEIGHT-HEIGHT RATIO.

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APPENDIX A

Student Data Sheet

SCHOOL _____

NUMBER OF YEARS YOU HAVE ATTENDED THIS SCHOOL 1 2 3 4 5

CLASS _____

NAME _____

SEX: BOY GIRL

OCCUPATION OF FATHER _____

AGE: _____ YEARS _____ MONTHS

HEIGHT: _____ INCHES

WEIGHT: _____ POUNDS

FLEXED ARM HANG _____ SECONDS

GRIP STRENGTH RIGHT HAND _____ POUNDS

GRIP STRENGTH LEFT HAND _____ POUNDS

PULL - UPS _____ NUMBER

Teacher Questionnaire

DEAR TEACHER,

PLEASE COMPLETE THE ATTACHED QUESTIONNAIRE IF YOU:

A) ARE TEACHING GRADE 4 PHYSICAL EDUCATION THIS YEAR, OR

B) TAUGHT GRADE 3 PHYSICAL EDUCATION IN THIS SCHOOL DURING 1968-1969, OR

C) TAUGHT GRADE 2 PHYSICAL EDUCATION IN THIS SCHOOL DURING 1967-1968, OR

D) TAUGHT GRADE 1 PHYSICAL EDUCATION IN THIS SCHOOL DURING 1966-1967, OR

E) WERE PRINCIPAL IN THIS SCHOOL DURING ANY OF THE FOREMENTIONED SCHOOL TERMS.

PLEASE CIRCLE THE LETTER(S) OF THE CATEGORY OR CATEGORIES WHICH CONCERN YOU.

THE QUESTIONNAIRE IS ONE OF THE SOURCES OF INFORMATION WHICH WILL BE USED TO DETERMINE IF THE USE OF FOLDAWAY CLIMBING APPARATUS HAS ANY EFFECT ON THE DEVELOPMENT OF UPPER BODY STRENGTH IN CHILDREN.

OTHER INFORMATION WILL BE OBTAINED BY ADMINISTERING STRENGTH TESTS TO 300 GRADE 4 PUPILS WHO HAVE USED THE CLIMBER 4 YEARS AND TO 200 PUPILS WHO HAVE NOT USED THE FOLDAWAY CLIMBER OVER THE SAME PERIOD, AND BY INTERVIEWING SELECTED TEACHERS REGARDING THE SPECIFIC PROGRAM WHICH WAS FOLLOWED DURING THIS TIME.

THE COLLECTED INFORMATION WILL SERVE AS THE BASIS FOR MY THESIS WHICH IS ONE OF THE REQUIREMENTS FOR THE MASTER OF EDUCATION DEGREE AT THE UNIVERSITY OF ALBERTA.

YOUR COOPERATION IN COMPLETING THE QUESTIONNAIRE IS GREATLY APPRECIATED.

SCHOOL: _____

NUMBER OF YEARS WHICH YOU HAVE BEEN IN THIS SCHOOL: _____

1. HOW MANY PHYSICAL EDUCATION COURSES HAVE YOU COMPLETED AT THE UNIVERSITY?

   A) NONE B) ½ C) 1 D) 1½ E) 2 F) 2½ G) 3 OR MORE

2. WHEN WAS THE LAST COURSE COMPLETED?

   A) BEFORE 1960 B) 1960 - 1966 C) AFTER 1966

3. WHICH OF THE FOLLOWING ACTIVITIES DO YOU INCLUDE IN THE PHYSICAL EDUCATION PROGRAM? PLEASE INDICATE WHAT PERCENTAGE OF THE TOTAL TIME DEVOTED TO PHYSICAL EDUCATION IN A YEAR IS SPENT ON THOSE ACTIVITIES.

___% A) SOCCER	___% I) SWIMMING
___% B) VOLLEYBALL	___% J) GYMNASTICS WITHOUT LARGE APPARATUS
___% C) BASKETBALL	___% K) GYMNASTICS WITH LARGE APPARATUS
___% D) SOFTBALL	___% L) RAQUET-TYPE GAMES
___% E) TAG	___% M) SKATING
___% F) CREATIVE DANCE	___% N) TRACK & FIELD
___% G) FOLK DANCE	___% O) OUTDOOR EDUCATION
___% H) SQUARE DANCE	___% P) OTHER (SPECIFY) _____
	100% TOTAL

4. ARE YOU SATISFIED WITH THE PHYSICAL EDUCATION PROGRAM IN YOUR SCHOOL?

   YES NO (IF NO, HOW CAN IT BE IMPROVED?)

5. ARE YOU SATISFIED WITH THE PHYSICAL EDUCATION FACILITIES AND EQUIPMENT IN YOUR SCHOOL? YES NO (IF NO, WHAT SHOULD BE ADDED?)

6. ADDITIONAL COMMENTS: (PLEASE USE BACK OF PAGE IF MORE SPACE IS REQUIRED.)

TO BE COMPLETED BY TEACHERS IN SCHOOLS WITH FOLDAWAY CLIMBING APPARATUS

7. WERE YOU TEACHING IN THIS SCHOOL WHEN THE CLIMBER WAS INSTALLED?

   YES (IF YES, PLEASE COMPLETE QUESTIONS 8, 9, 10.)

   NO (IF NO, PLEASE COMPLETE QUESTIONS 11, 12, 13.)

8. AT THE TIME WHEN THE APPARATUS WAS INSTALLED, DID YOU RECEIVE INSTRUCTIONS AS TO HOW THE APPARATUS COULD BE ASSEMBLED? YES NO

9. DID YOU RECEIVE INSTRUCTIONS AS TO HOW THE CHILDREN MIGHT USE THE APPARATUS?

   YES NO

10. DID YOU SEE THE APPARATUS USED WITH CHILDREN (DEMONSTRATION OR FILM) BEFORE YOU FIRST USED IT? YES NO

11. WHEN YOU CAME TO THIS SCHOOL, DID YOU RECEIVE INSTRUCTIONS AS TO HOW THE APPARATUS COULD BE ASSEMBLED? YES NO

12. DID YOU RECEIVE INSTRUCTIONS AS TO HOW THE CHILDREN MIGHT USE THE APPARATUS?

    YES NO

13. DID YOU SEE THE APPARATUS USED WITH CHILDREN (DEMONSTRATION OR FILM) BEFORE YOU FIRST USED IT? YES NO

PLEASE COMPLETE ALL OF THE FOLLOWING QUESTIONS

14. HOW MANY WEEKS DO YOU USE THE CLIMBER EACH YEAR?

    A) FEWER THAN 5 WEEKS B) 5 - 8 WEEKS C) 9 - 12 WEEKS D) MORE THAN 12 WEEKS

15. WHEN THE CLIMBER IS USED, HOW MANY MINUTES EACH CLASS PERIOD IS DEVOTED TO THE CLIMBER? A) FEWER THAN 5 MINUTES B) 5 - 10 MINUTES C) 11 - 15 MINUTES D) MORE THAN 15 MINUTES

16. IS OTHER APPARATUS USED IN ADDITION TO THE CLIMBER?

    A) NEVER B) SOMETIMES C) MOST OF THE TIME D) ALWAYS

17. HOW MANY CHILDREN USE THE CLIMBER AT ONE TIME? A) FEWER THAN 8 B) 8 - 15 C) 16 - 23 D) ALL CHILDREN IN THE CLASS

18. NUMBER OF MINUTES A TYPICAL CHILD USES THE CLIMBER EACH PERIOD _____

19. NUMBER OF PHYSICAL EDUCATION PERIODS EACH WEEK _____

APPENDIX B

FIGURE B - 7

LINEAR RELATIONSHIP BETWEEN WEIGHT-HEIGHT RATIO AND THE FLEXED ARM HANG FOR TOTAL SAMPLE

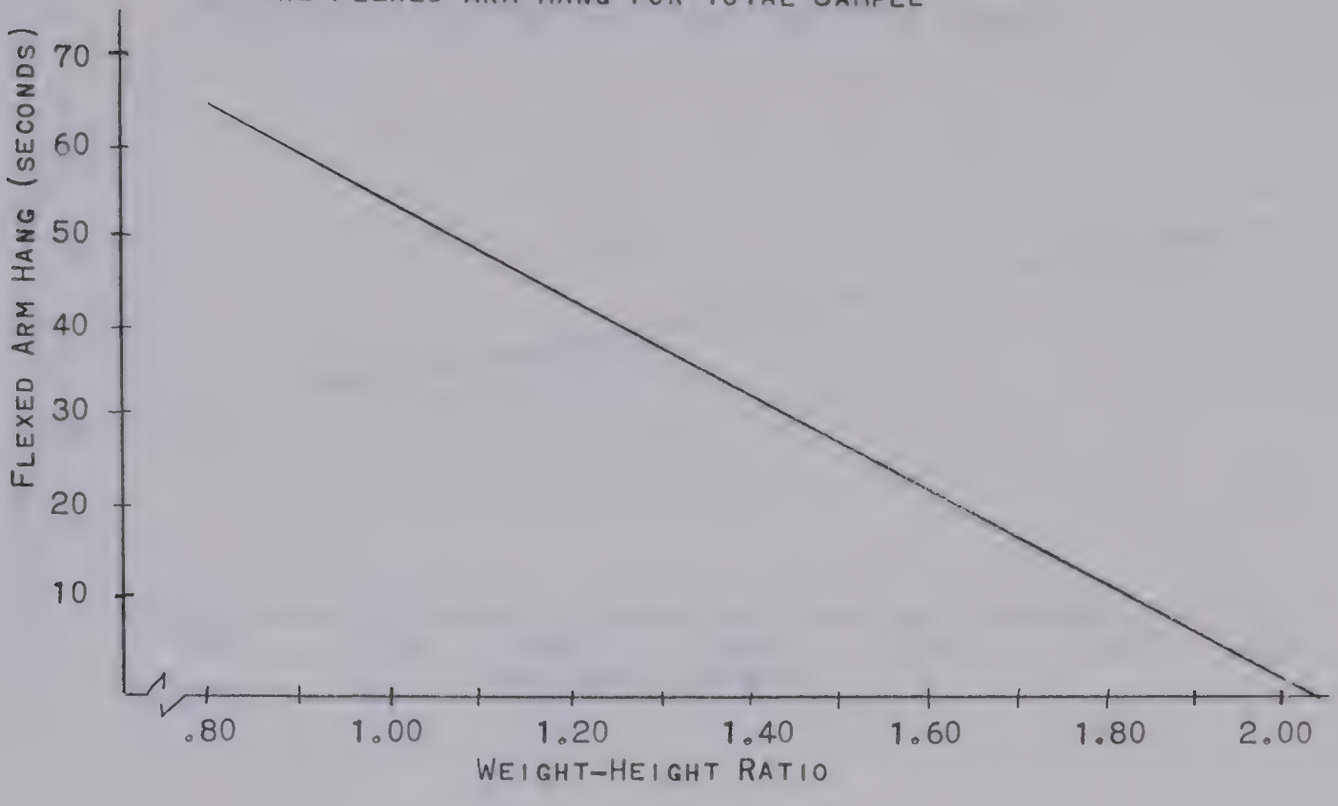


FIGURE B - 8

LINEAR RELATIONSHIP BETWEEN WEIGHT-HEIGHT RATIO AND GRIP STRENGTH OF THE RIGHT HAND FOR TOTAL SAMPLE

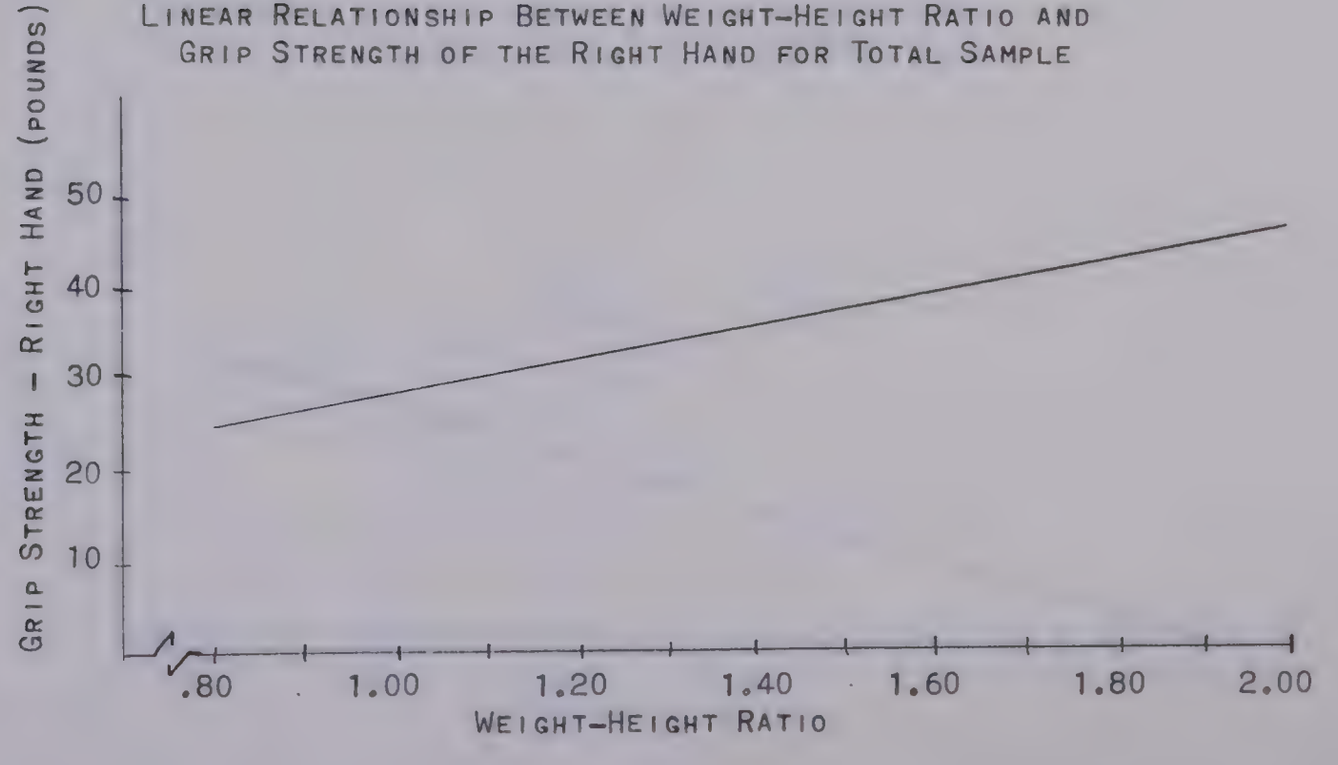


FIGURE B - 9

LINEAR RELATIONSHIP BETWEEN WEIGHT-HEIGHT RATIO AND GRIP STRENGTH OF THE LEFT HAND FOR TOTAL SAMPLE

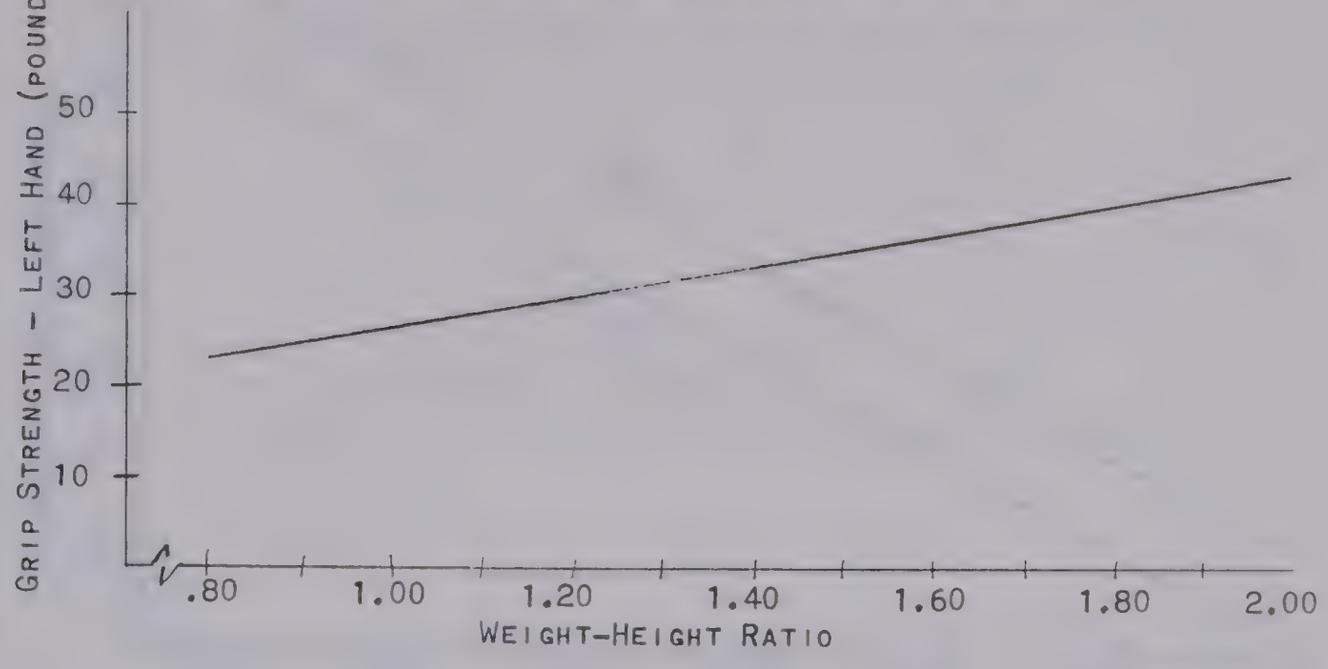


FIGURE B - 10

LINEAR RELATIONSHIP BETWEEN WEIGHT-HEIGHT RATIO AND PULL-UPS FOR TOTAL SAMPLE

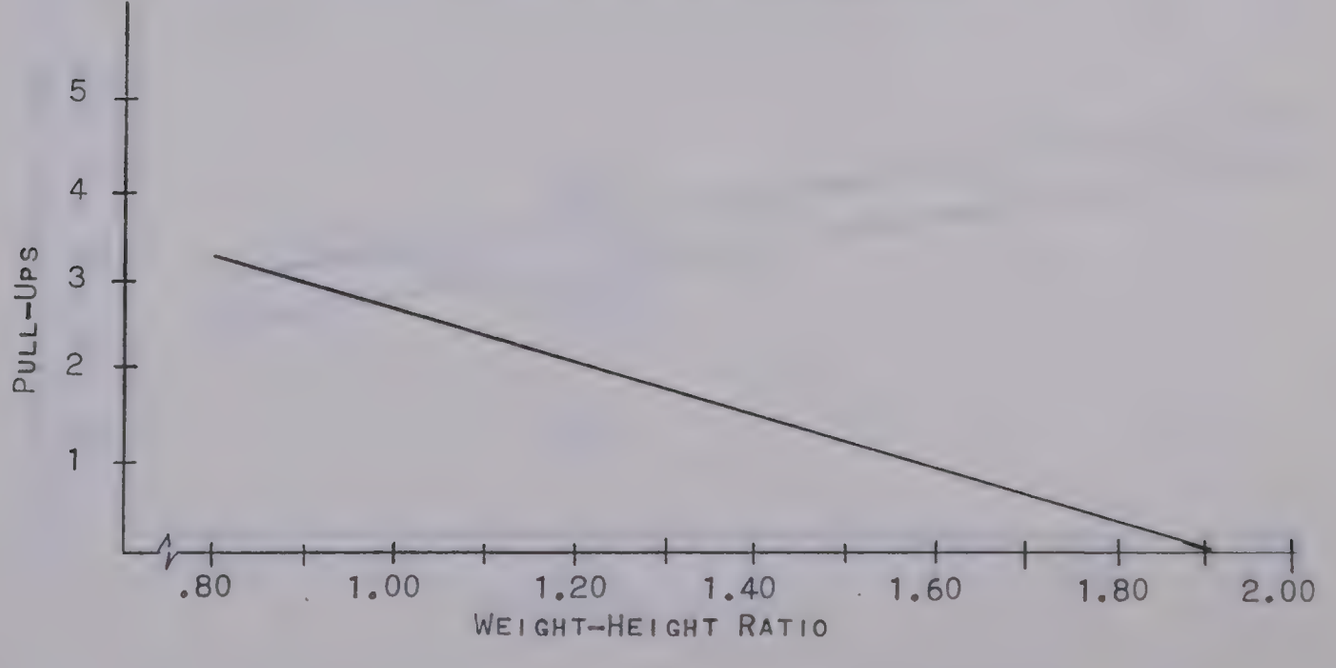


FIGURE B - 11

DIFFERENCES BETWEEN SEXES ON FLEXED ARM HANG WHEN WEIGHT-HEIGHT RATIO IS HELD CONSTANT

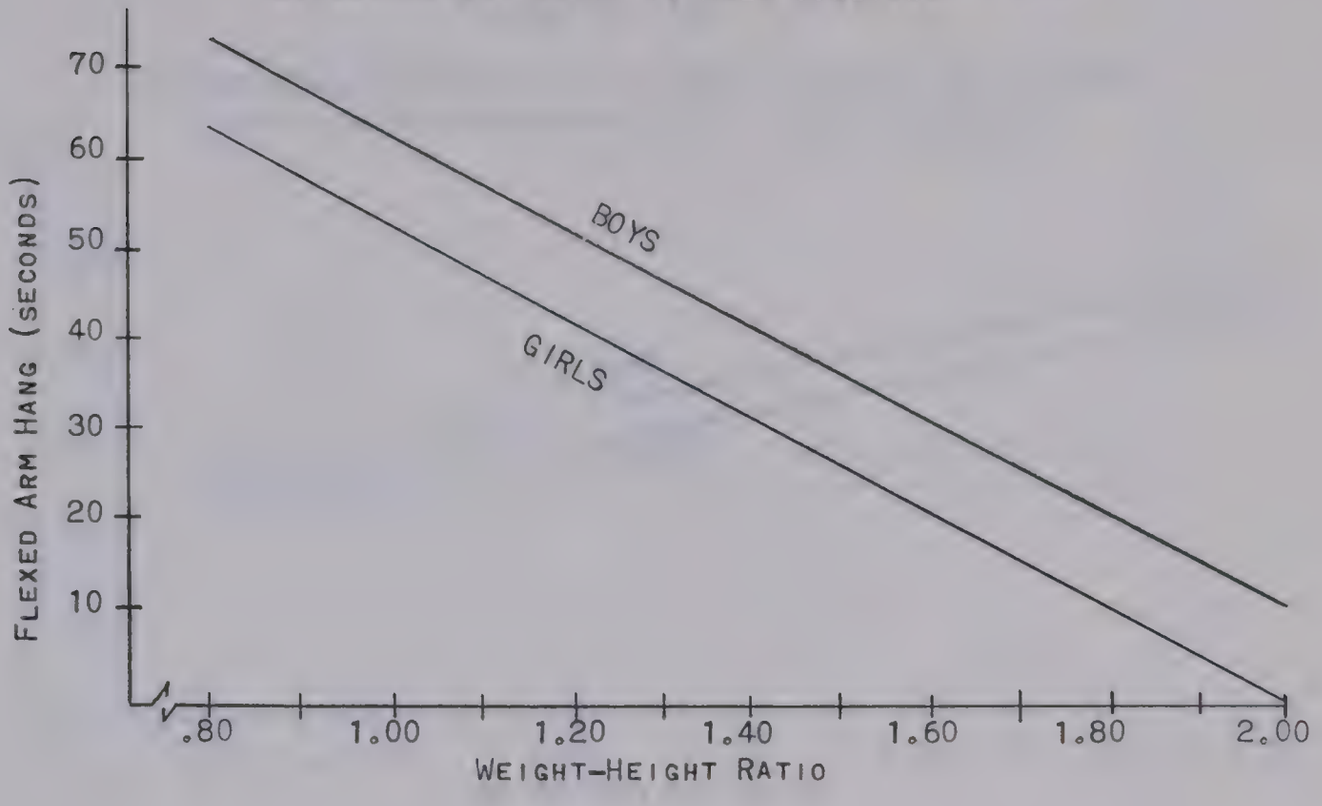


FIGURE B - 12

DIFFERENCES BETWEEN SEXES ON GRIP STRENGTH OF THE RIGHT HAND WHEN WEIGHT-HEIGHT RATIO IS HELD CONSTANT

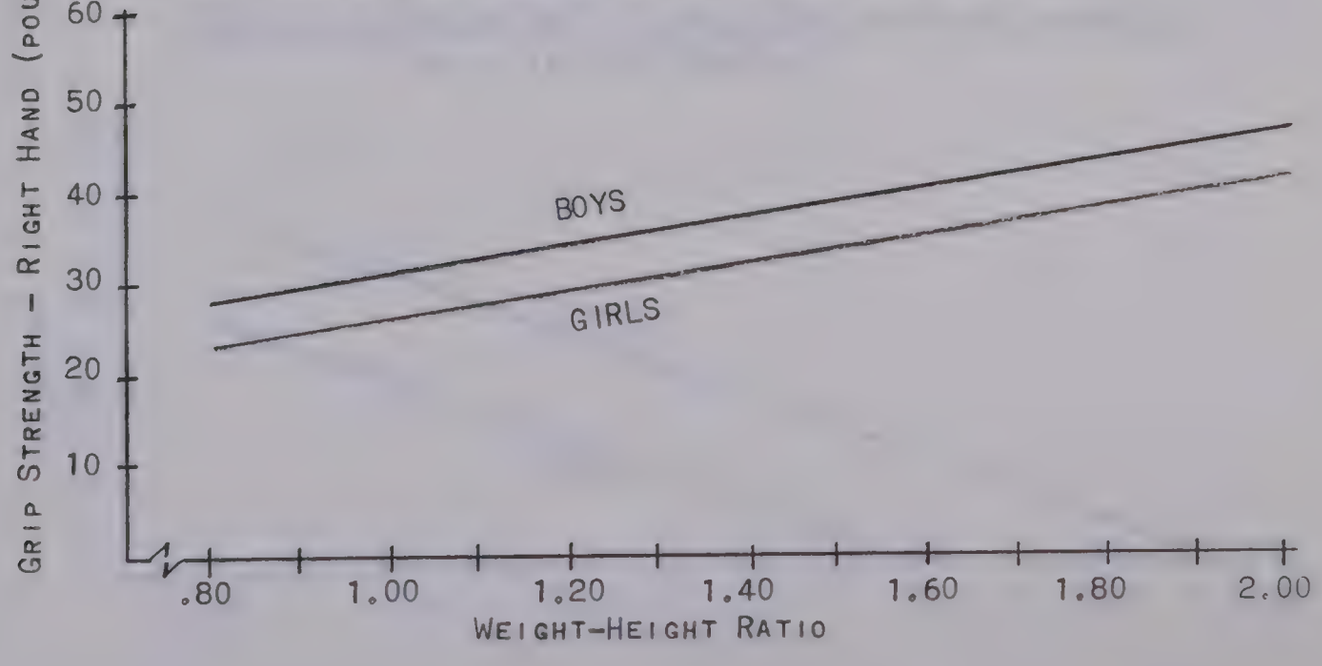


FIGURE B - 13

DIFFERENCES BETWEEN SEXES ON GRIP STRENGTH OF THE LEFT HAND WHEN WEIGHT-HEIGHT RATIO IS HELD CONSTANT

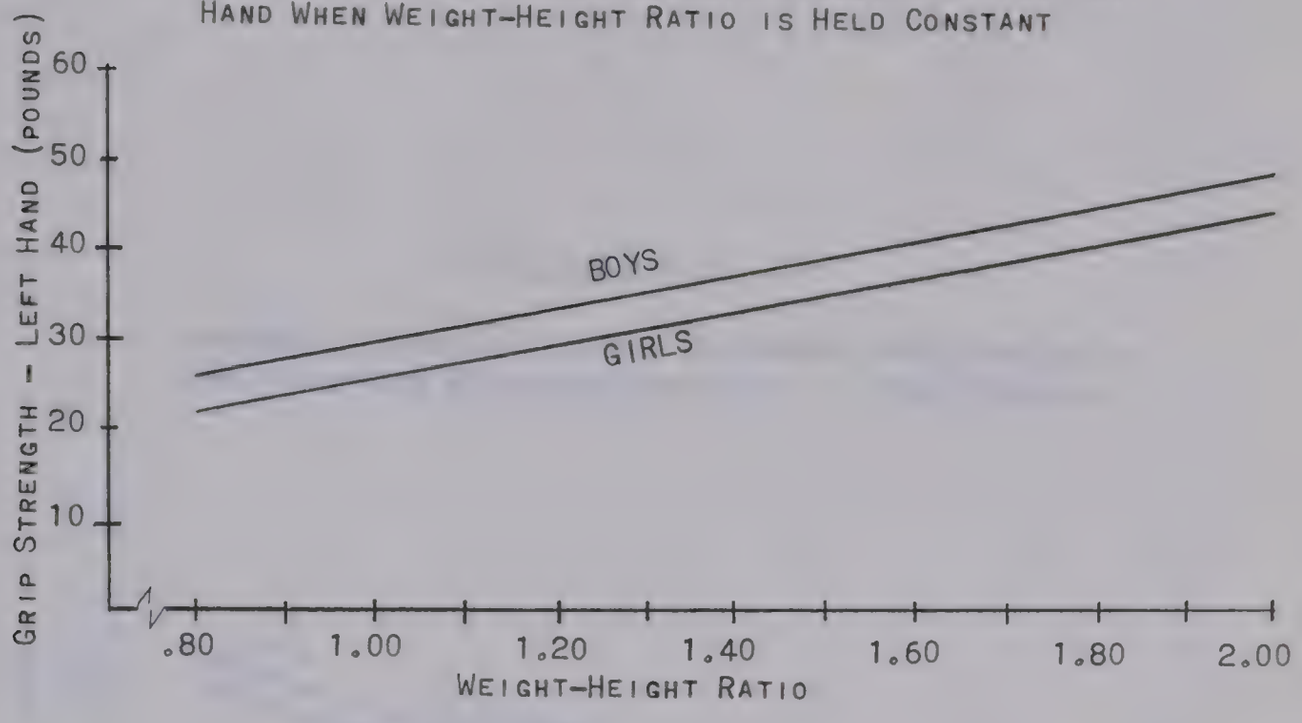


FIGURE B - 14

DIFFERENCES BETWEEN SEXES ON PULL-UPS WHEN WEIGHT-HEIGHT RATIO IS HELD CONSTANT

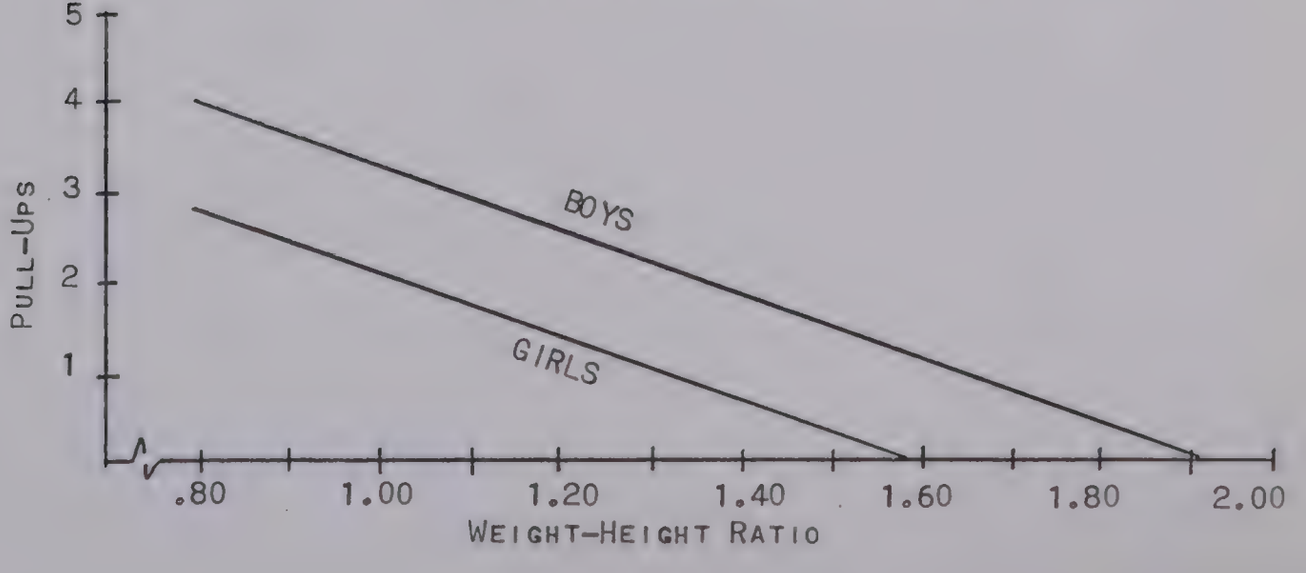
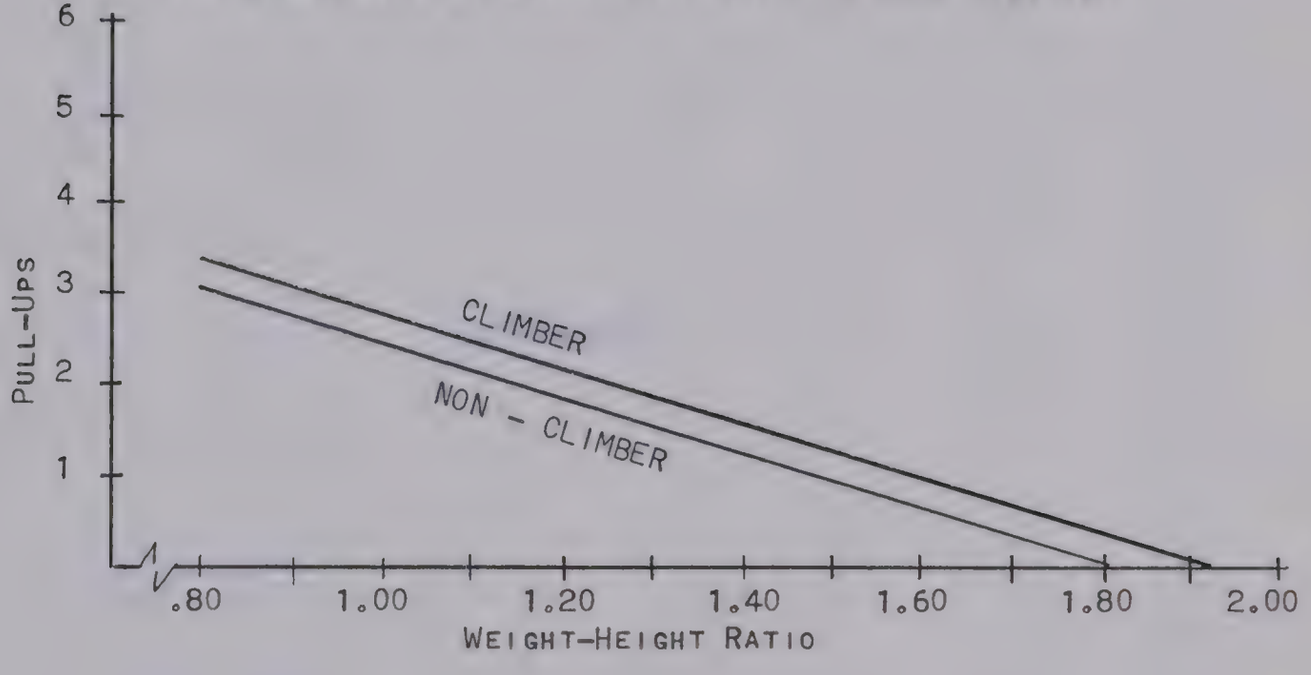


FIGURE B - 15

DIFFERENCES BETWEEN CLIMBER AND NON-CLIMBER GROUPS ON PULL-UPS WHEN WEIGHT-HEIGHT RATIO IS HELD CONSTANT



APPENDIX C

TABLE C - 8. DISTRIBUTION OF SCORES FOR FLEXED ARM HANG

***THE STATISTICS ON THIS PAGE REFER TO THE RAW DATA -
VARIABLE 5 MIN 1.000 MAX 161.000 WIDTH 3.265

NO.	INTERVAL		EXPFREQ	FREQ	CUMPROP	CONV
1	1.00	4.27	46.64	7.	0.007	0.0
2	4.27	7.53	11.37	27.	0.039	0.0
3	7.53	10.80	13.19	27.	0.090	0.0
4	10.80	14.06	15.07	23.	0.138	0.0
5	14.06	17.33	16.97	30.	0.188	0.0
6	17.33	20.59	18.84	23.	0.238	0.0
7	20.59	23.86	20.63	40.	0.298	0.0
8	23.86	27.12	22.29	29.	0.363	0.0
9	27.12	30.39	23.74	26.	0.416	0.0
10	30.39	33.65	24.90	34.	0.472	0.0
11	33.65	36.92	25.62	15.	0.519	0.0
12	36.92	40.18	25.75	21.	0.553	0.0
13	40.18	43.45	25.77	13.	0.585	0.0
14	43.45	46.71	25.56	17.	0.614	0.0
15	46.71	49.98	24.78	15.	0.644	0.0
16	49.98	53.24	23.59	34.	0.691	0.0
17	53.24	56.51	22.10	14.	0.736	0.0
18	56.51	59.78	20.42	7.	0.756	0.0
19	59.78	63.04	18.62	38.	0.799	0.0
20	63.04	66.31	16.75	10.	0.844	0.0
21	66.31	69.57	14.85	13.	0.866	0.0
22	69.57	72.84	12.98	13.	0.891	0.0
23	72.84	76.10	11.16	5.	0.908	0.0
24	76.10	79.37	9.45	3.	0.916	0.0
25	79.37	82.63	7.86	10.	0.928	0.0
26	82.63	85.90	6.43	3.	0.940	0.0
27	85.90	89.16	5.18	0.	0.943	0.0
28	89.16	92.43	4.09	4.	0.947	0.0
29	92.43	95.69	3.19	1.	0.952	0.0
30	95.69	98.96	2.44	1.	0.954	0.0
31	98.96	102.22	1.84	9.	0.963	0.0
32	102.22	105.49	1.37	3.	0.974	0.0
33	105.49	108.76	1.01	1.	0.978	0.0
34	108.76	112.02	0.74	2.	0.981	0.0
35	112.02	115.29	0.53	1.	0.984	0.0
36	115.29	118.55	0.38	0.	0.985	0.0
37	118.55	121.82	0.27	4.	0.989	0.0
38	121.82	125.08	0.19	1.	0.993	0.0
39	125.08	128.35	0.13	1.	0.995	0.0
40	128.35	131.61	0.09	1.	0.997	0.0
41	131.61	134.88	0.07	0.	0.998	0.0
42	134.88	138.14	0.05	0.	0.998	0.0
43	138.14	141.41	0.03	0.	0.998	0.0
44	141.41	144.67	0.02	0.	0.998	0.0
45	144.67	147.94	0.02	0.	0.998	0.0
46	147.94	151.20	0.01	0.	0.998	0.0
47	151.20	154.47	0.01	0.	0.998	0.0
48	154.47	157.73	0.01	0.	0.998	0.0
49	157.73	161.00	0.00	0.	0.998	0.0
50	161.00	164.27	0.01	1.	0.999	0.0

FIGURE C – 16. HISTOGRAM OF RAW SCORES FOR FLEXED ARM HANG

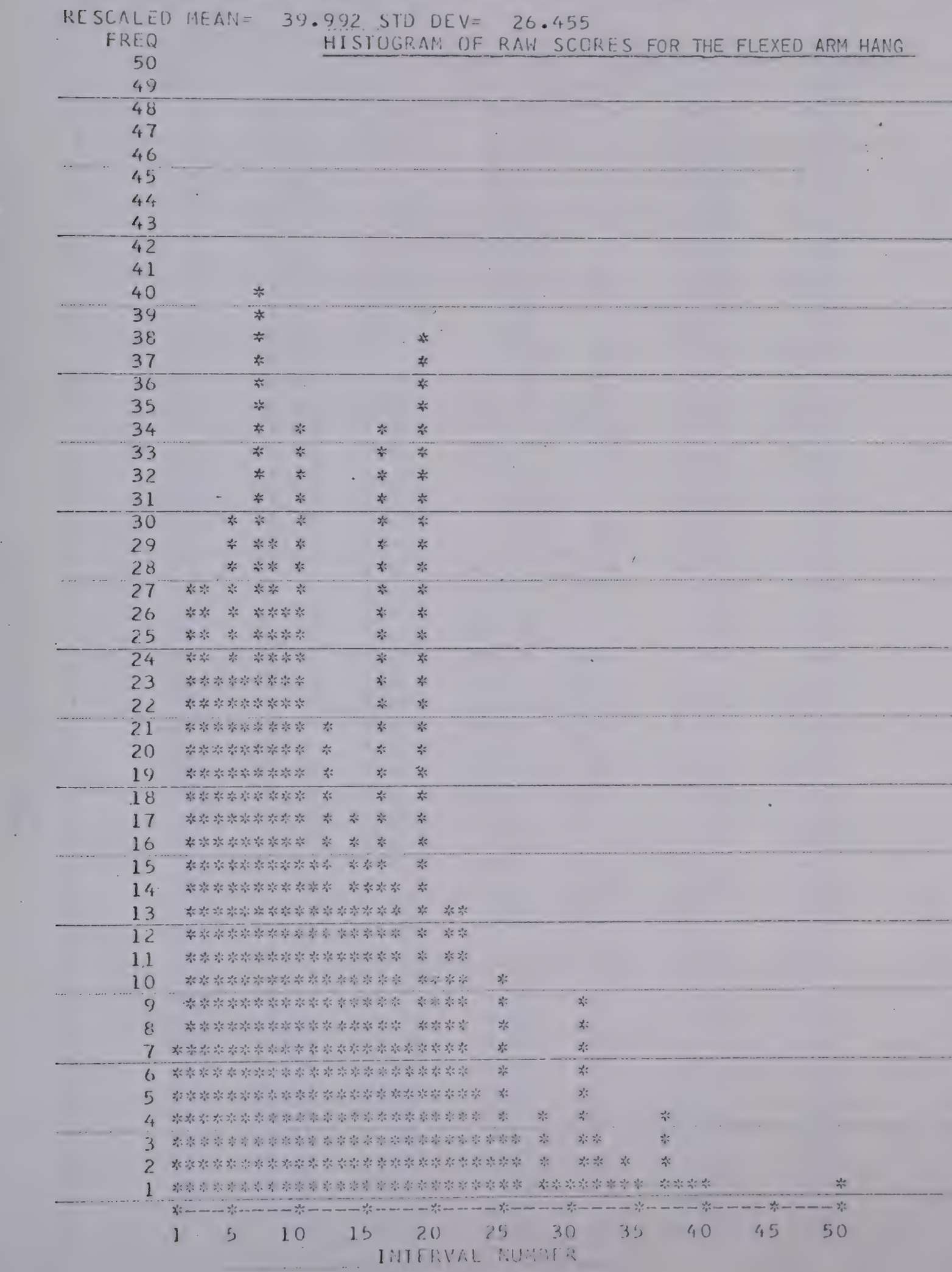


TABLE C - 9. DISTRIBUTION OF SCORES FOR GRIP STRENGTH OF RIGHT HAND

***THE STATISTICS ON THIS PAGE REFER TO THE RAW DATA -
VARIABLE 6 MIN 8.800 MAX 57.200 WIDTH 0.988

NO.	INTERVAL		EXFREQ	FREQ	CUMPROP	CONV
1	8.80	9.79	0.44	1.	0.001	0.0
2	9.79	10.78	0.20	0.	0.002	0.0
3	10.78	11.76	0.29	0.	0.002	0.0
4	11.76	12.75	0.42	0.	0.002	0.0
5	12.75	13.74	0.60	2.	0.004	0.0
6	13.74	14.73	0.85	0.	0.006	0.0
7	14.73	15.71	1.18	1.	0.007	0.0
8	15.71	16.70	1.63	0.	0.008	0.0
9	16.70	17.69	2.22	5.	0.012	0.0
10	17.69	18.68	2.98	0.	0.017	0.0
11	18.68	19.67	3.92	0.	0.017	0.0
12	19.67	20.65	5.06	5.	0.022	0.0
13	20.65	21.64	6.42	0.	0.027	0.0
14	21.64	22.63	7.99	20.	0.046	0.0
15	22.63	23.62	9.74	0.	0.065	0.0
16	23.62	24.60	11.67	26.	0.089	0.0
17	24.60	25.59	13.71	0.	0.114	0.0
18	25.59	26.58	15.83	31.	0.143	0.0
19	26.58	27.57	17.98	0.	0.173	0.0
20	27.57	28.56	20.09	0.	0.173	0.0
21	28.56	29.54	22.11	61.	0.231	0.0
22	29.54	30.53	23.97	0.	0.288	0.0
23	30.53	31.52	25.56	63.	0.348	0.0
24	31.52	32.51	26.76	0.	0.408	0.0
25	32.51	33.49	27.39	64.	0.469	0.0
26	33.49	34.48	27.37	0.	0.529	0.0
27	34.48	35.47	27.40	65.	0.591	0.0
28	35.47	36.46	26.81	0.	0.653	0.0
29	36.46	37.44	25.64	44.	0.694	0.0
30	37.44	38.43	24.07	0.	0.736	0.0
31	38.43	39.42	22.23	0.	0.736	0.0
32	39.42	40.41	20.21	39.	0.773	0.0
33	40.41	41.40	18.10	0.	0.810	0.0
34	41.40	42.38	15.96	32.	0.841	0.0
35	42.38	43.37	13.83	0.	0.871	0.0
36	43.37	44.36	11.78	27.	0.897	0.0
37	44.36	45.35	9.85	0.	0.922	0.0
38	45.35	46.33	8.08	21.	0.942	0.0
39	46.33	47.32	6.50	0.	0.962	0.0
40	47.32	48.31	5.13	0.	0.962	0.0
41	48.31	49.30	3.98	3.	0.965	0.0
42	49.30	50.29	3.02	0.	0.968	0.0
43	50.29	51.27	2.26	11.	0.978	0.0
44	51.27	52.26	1.66	0.	0.989	0.0
45	52.26	53.25	1.21	2.	0.991	0.0
46	53.25	54.24	0.86	0.	0.992	0.0
47	54.24	55.22	0.61	2.	0.994	0.0
48	55.22	56.21	0.43	0.	0.996	0.0
49	56.21	57.20	0.30	0.	0.996	0.0
50	57.20	58.19	0.66	2.	0.998	0.0

FIGURE C - 17. HISTOGRAM OF RAW SCORES FOR GRIP STRENGTH OF RIGHT HAND

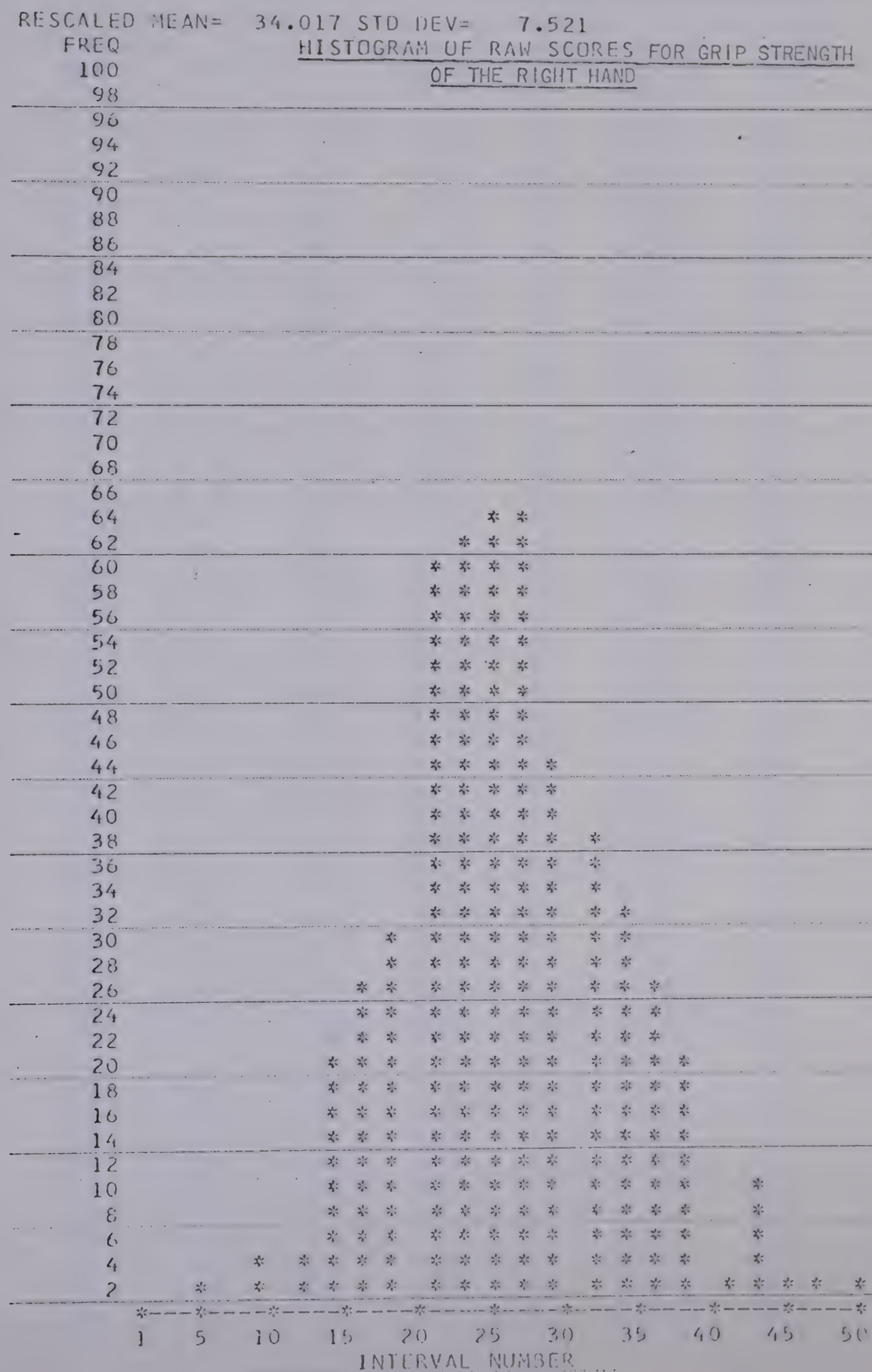


TABLE C - 10. DISTRIBUTION OF SCORES FOR GRIP STRENGTH OF LEFT HAND

***THE STATISTICS ON THIS PAGE REFER TO THE RAW DATA -
VARIABLE 7 MIN 13.200 MAX 59.400 WIDTH 0.943

NO.	INTERVAL		EXFREQ	FREQ	CUMPROP	CONV
1	13.20	14.14	3.07	1.	0.001	0.0
2	14.14	15.09	1.26	0.	0.002	0.0
3	15.09	16.03	1.73	3.	0.005	0.0
4	16.03	16.97	2.33	0.	0.008	0.0
5	16.97	17.91	3.09	6.	0.013	0.0
6	17.91	18.86	4.03	0.	0.019	0.0
7	18.86	19.80	5.17	0.	0.019	0.0
8	19.80	20.74	6.52	8.	0.027	0.0
9	20.74	21.69	8.06	0.	0.034	0.0
10	21.69	22.63	9.78	25.	0.058	0.0
11	22.63	23.57	11.64	0.	0.082	0.0
12	23.57	24.51	13.63	45.	0.124	0.0
13	24.51	25.46	15.68	0.	0.167	0.0
14	25.46	26.40	17.75	1.	0.168	0.0
15	26.40	27.34	19.79	36.	0.203	0.0
16	27.34	28.29	21.75	0.	0.237	0.0
17	28.29	29.23	23.54	62.	0.296	0.0
18	29.23	30.17	25.08	0.	0.355	0.0
19	30.17	31.11	26.25	69.	0.420	0.0
20	31.11	32.06	26.90	0.	0.486	0.0
21	32.06	33.00	26.90	0.	0.486	0.0
22	33.00	33.94	26.95	70.	0.552	0.0
23	33.94	34.89	26.45	0.	0.619	0.0
24	34.89	35.83	25.38	46.	0.662	0.0
25	35.83	36.77	23.91	0.	0.706	0.0
26	36.77	37.71	22.16	49.	0.752	0.0
27	37.71	38.66	20.24	0.	0.799	0.0
28	38.66	39.60	18.21	0.	0.799	0.0
29	39.60	40.54	16.14	34.	0.831	0.0
30	40.54	41.49	14.08	1.	0.864	0.0
31	41.49	42.43	12.08	22.	0.886	0.0
32	42.43	43.37	10.18	0.	0.907	0.0
33	43.37	44.31	8.42	21.	0.927	0.0
34	44.31	45.26	6.84	0.	0.947	0.0
35	45.26	46.20	5.46	0.	0.947	0.0
36	46.20	47.14	4.27	14.	0.960	0.0
37	47.14	48.09	3.23	0.	0.973	0.0
38	48.09	49.03	2.48	4.	0.977	0.0
39	49.03	49.97	1.85	0.	0.981	0.0
40	49.97	50.91	1.35	5.	0.986	0.0
41	50.91	51.86	0.98	0.	0.991	0.0
42	51.86	52.80	0.70	0.	0.991	0.0
43	52.80	53.74	0.50	3.	0.993	0.0
44	53.74	54.69	0.35	0.	0.996	0.0
45	54.69	55.63	0.24	0.	0.996	0.0
46	55.63	56.57	0.17	0.	0.996	0.0
47	56.57	57.51	0.12	1.	0.997	0.0
48	57.51	58.46	0.08	0.	0.998	0.0
49	58.46	59.40	0.06	0.	0.998	0.0
50	59.40	60.34	0.12	1.	0.999	0.0

FIGURE C - 18. HISTOGRAM OF RAW SCORES FOR GRIP STRENGTH OF LEFT HAND

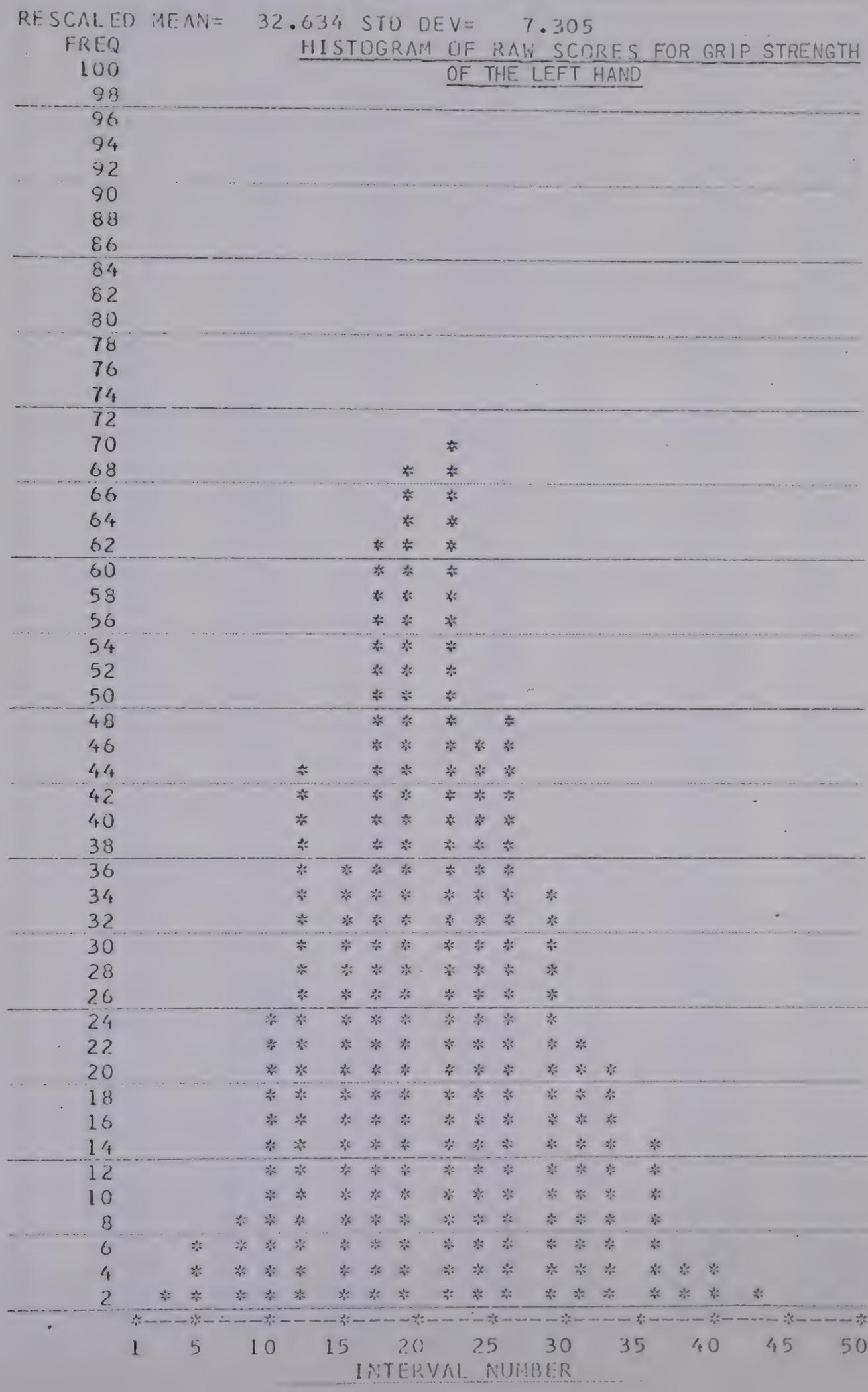


TABLE C - 11. DISTRIBUTION OF SCORES FOR PULL-UPS

***THE STATISTICS ON THIS PAGE REFER TO THE RAW DATA -
VARIABLE 8 MIN 0.100 MAX 12.500 WIDTH 0.253

NO.	INTERVAL		EXFREQ	FREQ	CUMPROP	CONV
1	0.10	0.35	138.31	182.	0.173	8.11
2	0.35	0.61	20.99	63.	0.405	9.52
3	0.61	0.86	22.38	0.	0.465	9.82
4	0.86	1.11	23.53	73.	0.534	10.17
5	1.11	1.37	24.34	0.	0.603	10.52
6	1.37	1.62	24.69	18.	0.620	10.61
7	1.62	1.87	24.62	0.	0.638	10.70
8	1.87	2.12	24.65	42.	0.677	10.92
9	2.12	2.38	24.13	0.	0.717	11.15
10	2.38	2.63	23.27	21.	0.737	11.27
11	2.63	2.88	22.06	0.	0.757	11.39
12	2.88	3.14	20.62	37.	0.792	11.63
13	3.14	3.39	19.04	0.	0.827	11.89
14	3.39	3.64	17.36	18.	0.844	12.03
15	3.64	3.90	15.64	0.	0.861	12.17
16	3.90	4.15	13.90	17.	0.878	12.33
17	4.15	4.40	12.19	0.	0.894	12.49
18	4.40	4.66	10.53	2.	0.896	12.51
19	4.66	4.91	8.97	0.	0.898	12.54
20	4.91	5.16	7.52	17.	0.914	12.73
21	5.16	5.41	6.21	0.	0.930	12.95
22	5.41	5.67	5.04	3.	0.933	12.99
23	5.67	5.92	4.04	0.	0.935	13.04
24	5.92	6.17	3.18	7.	0.942	13.15
25	6.17	6.43	2.47	0.	0.949	13.27
26	6.43	6.68	1.89	3.	0.952	13.32
27	6.68	6.93	1.43	0.	0.954	13.38
28	6.93	7.19	1.07	10.	0.964	13.60
29	7.19	7.44	0.79	0.	0.973	13.87
30	7.44	7.69	0.58	1.	0.974	13.90
31	7.69	7.94	0.42	0.	0.975	13.93
32	7.94	8.20	0.31	2.	0.977	14.00
33	8.20	8.45	0.22	0.	0.979	14.07
34	8.45	8.70	0.16	1.	0.980	14.11
35	8.70	8.96	0.11	0.	0.981	14.15
36	8.96	9.21	0.08	1.	0.982	14.19
37	9.21	9.46	0.06	0.	0.983	14.24
38	9.46	9.72	0.04	1.	0.984	14.28
39	9.72	9.97	0.03	0.	0.985	14.33
40	9.97	10.22	0.02	7.	0.991	14.77
41	10.22	10.48	0.01	0.	0.998	15.79
42	10.48	10.73	0.01	0.	0.998	15.79
43	10.73	10.98	0.01	0.	0.998	15.79
44	10.98	11.23	0.01	0.	0.998	15.79
45	11.23	11.49	0.00	0.	0.998	15.79
46	11.49	11.74	0.00	0.	0.998	15.79
47	11.74	11.99	0.00	0.	0.998	15.79
48	11.99	12.25	0.00	0.	0.998	15.79
49	12.25	12.50	0.00	0.	0.998	15.79
50	12.50	12.75	0.00	1.	0.999	16.21

FIGURE C - 19. HISTOGRAM OF RAW SCORES FOR PULL-UPS

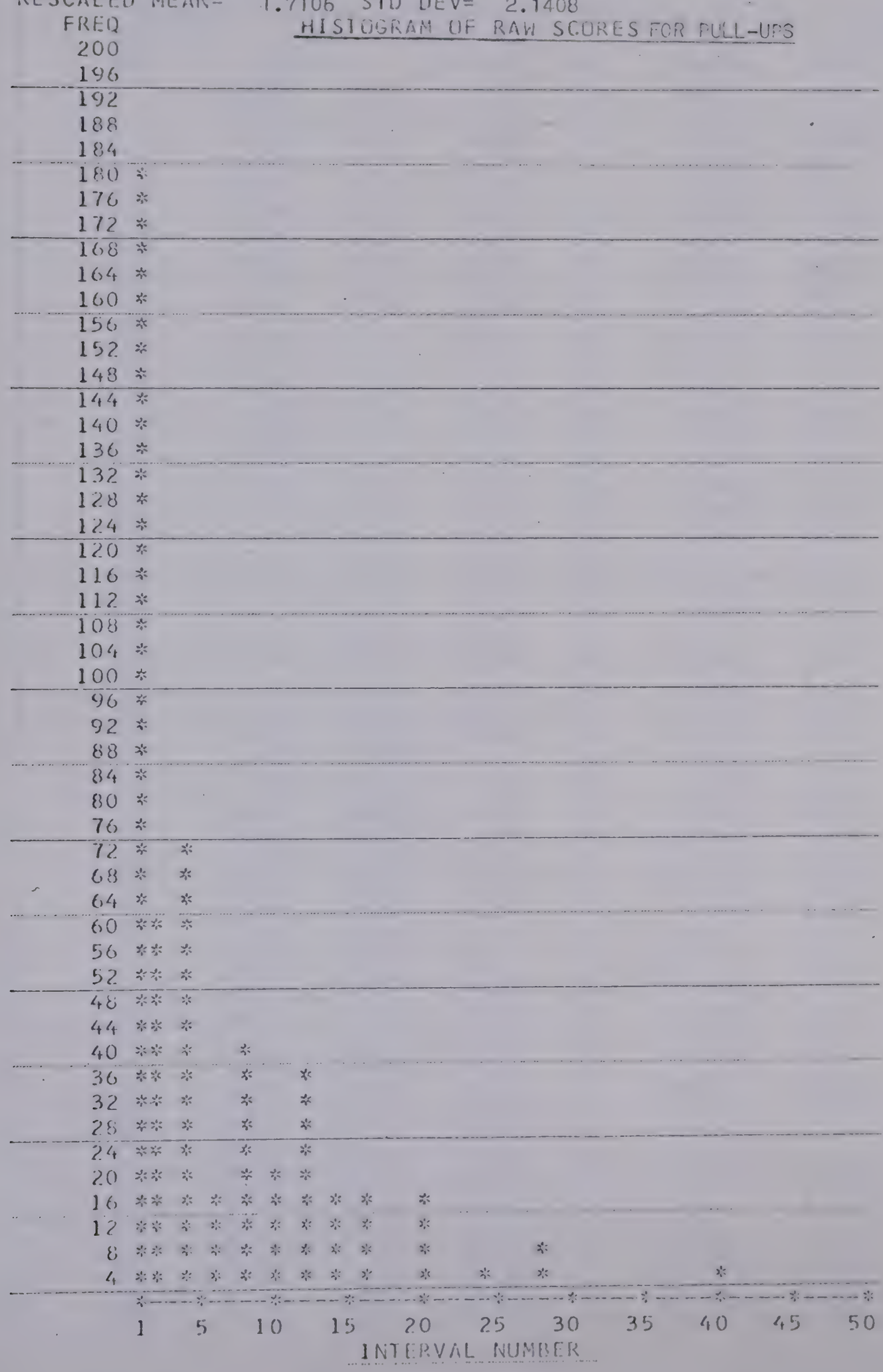
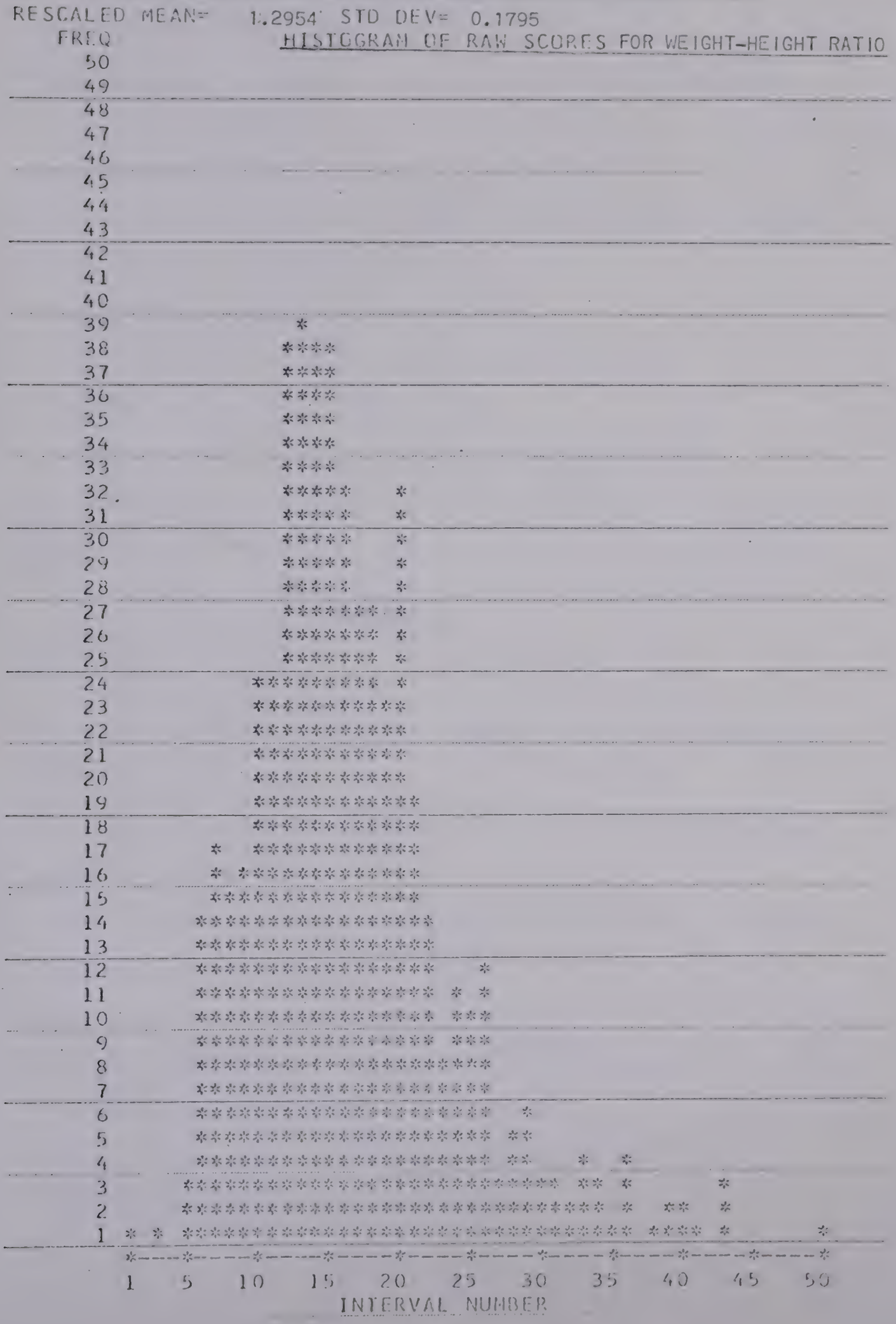


TABLE C - 12. DISTRIBUTION OF SCORES FOR WEIGHT-HEIGHT RATIO

***THE STATISTICS ON THIS PAGE REFER TO THE RAW DATA -
VARIABLE 9 MIN 0.891 MAX 2.117 WIDTH 0.025

NO.	INTERVAL		EXFREQ	FREQ	CUMPROP	CONV
1	0.89	0.92	9.16	1.	0.001	0.56
2	0.92	0.94	3.63	0.	0.002	0.59
3	0.94	0.97	4.80	1.	0.003	0.62
4	0.97	0.99	6.23	0.	0.004	0.65
5	0.99	1.02	7.90	3.	0.007	0.68
6	1.02	1.04	9.81	14.	0.023	0.70
7	1.04	1.07	11.93	17.	0.052	0.73
8	1.07	1.09	14.20	15.	0.083	0.76
9	1.09	1.12	16.56	16.	0.112	0.79
10	1.12	1.14	18.97	24.	0.150	0.81
11	1.14	1.17	21.33	24.	0.195	0.84
12	1.17	1.19	23.59	38.	0.254	0.87
13	1.19	1.22	25.63	39.	0.327	0.90
14	1.22	1.24	27.35	38.	0.400	0.93
15	1.24	1.27	28.56	38.	0.472	0.95
16	1.27	1.29	29.03	32.	0.539	0.98
17	1.29	1.32	28.99	27.	0.595	1.01
18	1.32	1.34	28.81	27.	0.646	1.04
19	1.34	1.37	27.82	23.	0.694	1.06
20	1.37	1.39	26.25	32.	0.746	1.09
21	1.39	1.42	24.30	19.	0.794	1.12
22	1.42	1.44	22.10	14.	0.825	1.15
23	1.44	1.47	19.76	8.	0.846	1.18
24	1.47	1.49	17.36	11.	0.864	1.20
25	1.49	1.52	14.98	10.	0.884	1.23
26	1.52	1.54	12.67	12.	0.905	1.26
27	1.54	1.57	10.50	3.	0.919	1.29
28	1.57	1.59	8.51	5.	0.927	1.32
29	1.59	1.62	6.76	6.	0.937	1.34
30	1.62	1.64	5.25	3.	0.946	1.37
31	1.64	1.67	3.99	3.	0.952	1.40
32	1.67	1.69	2.98	2.	0.956	1.43
33	1.69	1.72	2.18	4.	0.962	1.45
34	1.72	1.74	1.57	3.	0.969	1.48
35	1.74	1.77	1.11	1.	0.972	1.51
36	1.77	1.79	0.77	4.	0.977	1.54
37	1.79	1.82	0.53	0.	0.981	1.57
38	1.82	1.84	0.37	1.	0.982	1.59
39	1.84	1.87	0.25	2.	0.985	1.62
40	1.87	1.89	0.17	2.	0.989	1.65
41	1.89	1.92	0.11	1.	0.991	1.68
42	1.92	1.94	0.08	0.	0.992	1.70
43	1.94	1.97	0.05	3.	0.995	1.73
44	1.97	1.99	0.03	0.	0.998	1.76
45	1.99	2.02	0.02	0.	0.998	1.79
46	2.02	2.04	0.01	0.	0.998	1.82
47	2.04	2.07	0.01	0.	0.998	1.84
48	2.07	2.09	0.01	0.	0.998	1.87
49	2.09	2.12	0.00	0.	0.998	1.90
50	2.12	2.14	0.01	1.	0.999	1.93

FIGURE C – 20. HISTOGRAM OF RAW SCORES FOR WEIGHT-HEIGHT RATIO



APPENDIX D

Summary of Findings From Teacher Questionnaires

Findings pertaining to all eight schools.

1. The majority of teachers have one full course or less in physical education at university.
2. Most teachers have taken this course before 1960.
3. Between 40% and 60% of physical education time is spent on activities which may affect upper body strength.
4. Most teachers and principals feel that:
   a) more equipment is needed for physical education,
   b) a second gymnasium is needed,
   c) storage facilities for equipment are inadequate, and
   d) there is a great need for specialists to teach physical education.

Findings pertaining only to the four schools with the climbing apparatus.

1. Most teachers were in the school four years before when climbing apparatus was installed.
2. Teachers in the school at the time of installation were shown how to use the apparatus, but teachers coming later generally were not shown how to use it.
3. Most schools with the climbing apparatus use it at least ten weeks during each school year.
4. Other equipment is used in conjunction with the climbing apparatus almost all of the time.
5. Ten to fifteen children are usually on the apparatus at any given time.
6. Each child uses the apparatus approximately ten minutes during each of the two periods each week.
7. Thus, a typical child will use the apparatus approximately two hundred minutes during each school year.